SCIENTIFIC AMERICAN

The Most Powerful Locomotive
Successful Test of Langleys' Flying Machine
New York's Polluted Waters

Vol. CX. No. 24
June 13, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

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SEVENTIETH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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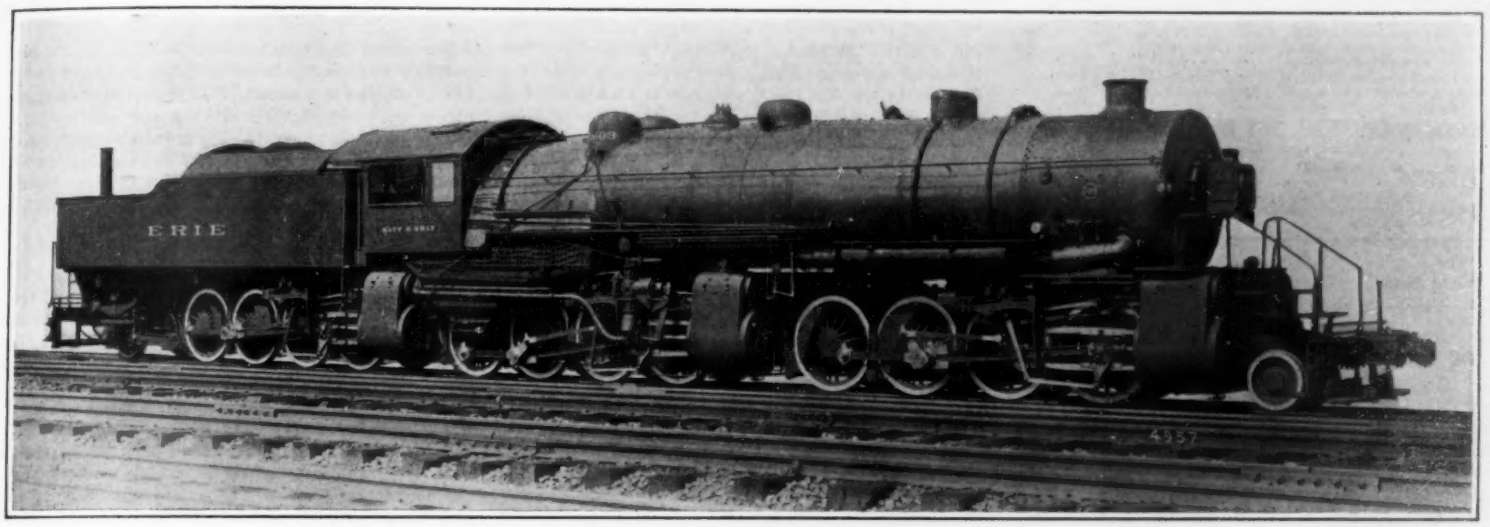
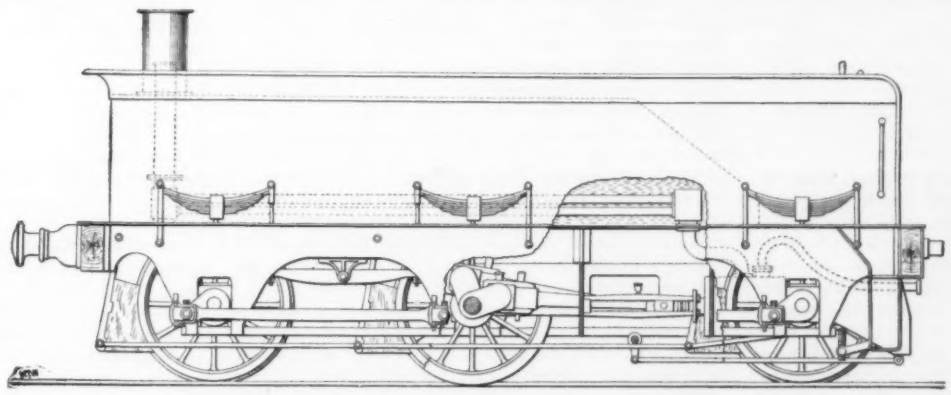


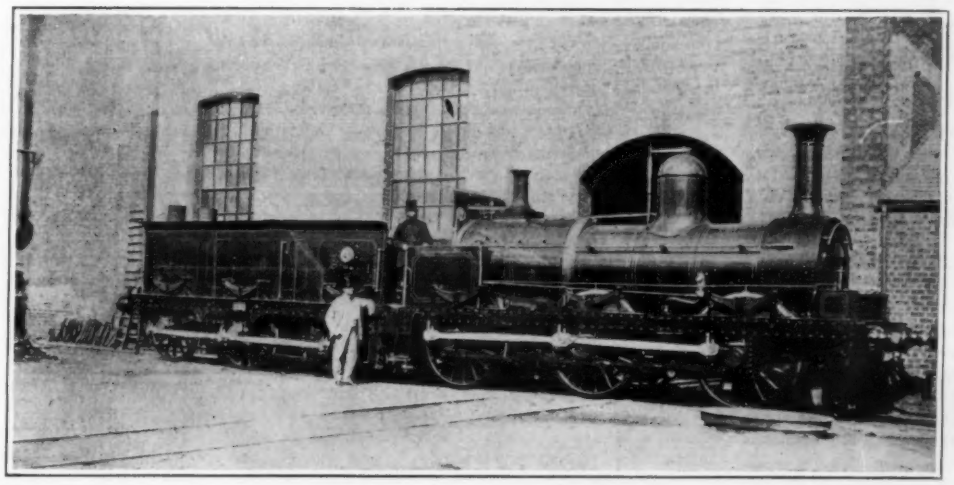
The Erie "pusher," largest locomotive in world. Weight, 853,000 pounds; tractive effort, 160,000 pounds.

The World's Largest Locomotive

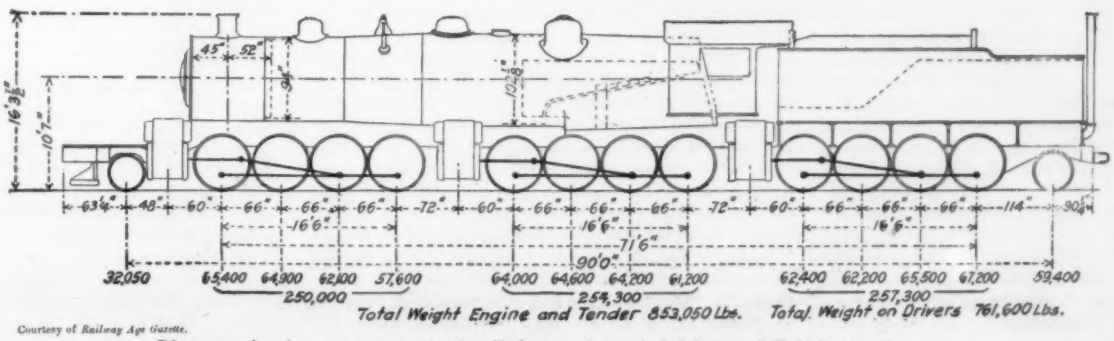
THE engineers and naval architects are doing some big things in the way of construction just now, as the recent arrival of the "Vaterland" and the "Aquitania" at this port has shown; and the illustrations which we present of the great Erie freight locomotive give evidence that in that other great field of transportation, the railway, the engineer is also building in ever-increasing sizes and weights. This most interesting locomotive has recently been completed for the Erie Railroad from designs by G. R. Henderson, consulting engineer of the Baldwin Locomotive Works. It is the heaviest and most powerful locomotive ever constructed, its total weight being 853,050 pounds. The greatest advance of this over existing freight locomotives has been in the matter of tractive effort. Hitherto the most powerful freight locomotive was what is known as the Virginian Mallet, which, when working compound, has a tractive effort of 115,000 pounds. The tractive effort of the new Erie locomotive is 160,000 pounds, or a direct pull on the drawbar of eighty American tons. The locomotive has been built for the pusher service on an 8-mile stretch of grade east of Susquehanna, Pa., which has an average rise of 56 feet to the mile. The new locomotive, which is known as the Triplex Compound, will take the place on full tonnage trains of three separate pushers, as now used.



Sectional view, showing engine and condenser on tender.



Old photograph of a Sturrock engine of 1863, with auxiliary engine under the tender.



Courtesy of *Railway Age Gazette.*

Diagram showing arrangement of cylinders and coupled drivers of Erie locomotive.

It will be seen at a glance that the novelty in this locomotive consists in the fact that, in addition to the two separate engines placed under the locomotive proper, which are the characteristic feature of the Mallet type, a third engine has been placed under the tender, whose weight is thus brought into service for tractive effort. An interesting feature is the fact that the three locomotives with their sets of coupled drivers are identical in dimensions, all cylinders being 36 inches in diameter by 32 inches in stroke, and all having 16-inch piston valves and the Baker valve gear. Steam at a pressure of 210 pounds to the inch is led to the central pair of cylinders. The exhaust steam from the cylinder on one side is led to the forward low-pressure pair of cylinders, and that from the cylinder on the opposite side is led to the after pair of low-pressure cylinders. The ratio of expansion is therefore 1 to 2.

The boiler is of enormous proportions. At the front end it is 94 inches in diameter and at the dome ring 108⅛ inches in diameter. The firebox, of the radial-stay type, is 162 inches long and 108 inches wide at the mud ring. The locomotive is fired by a mechanical stoker. Superheated steam is used, of course, and the Schmidt superheater, the largest ever applied to a locomo-

(Concluded on page 492.)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The One Great Lesson of the St. Lawrence Disaster

IN the case of great calamities, such as the sinking of the "Empress of Ireland" with a loss of over 1,000 souls, there is a danger that the one great lesson of the disaster may be lost sight of in the consideration of questions of relatively minor importance. The alarming fact in this case is that this comparatively new and very fine ship went to the bottom in fourteen minutes after the collision.

The large modern passenger steamer carries a small townful of people. In the designing of such a ship there are many requirements to be met; but there is one requirement which in importance transcends all the others, and this is that, if from two to five thousand people are to be committed to her keeping, and she is to be sent across many thousand miles of ocean water, she should be so built that she is practically unsinkable.

Let us suppose that no such vessel had ever been constructed, and that, to-day, for the first time, the problem was put up to the naval architect and the engineer to provide a 20-knot ship capable of carrying several thousand people across the Atlantic. It is perfectly certain that, if no restrictions of a commercial kind were imposed upon him, the designer, realizing the priceless value of the human freight that was to be committed to her care, would see to it that her construction was such as to render her practically unsinkable by any of the accidents of ocean travel. Having built her so, he would then proceed to provide the necessary accommodations for boilers and engines, and for the housing and comfort of her passengers and crew. As a matter of fact, when the first of the great ocean liners, the "Great Eastern," was under consideration, her designers, Brunel, the engineer, and Scott Russell, the naval architect, did make this the first consideration. They built the ship with a double hull, one within the other, with a suitable space between them, said space being divided and subdivided into a multitude of watertight compartments. This double hull extended from stem to stern, and it was carried some ten to twelve feet above the water-line, at which point it was covered in by an iron, watertight deck. The double hull as thus provided was subdivided by a large number of stout watertight bulkheads extending transversely across the ship. Also there were run longitudinally through the ship, two bulkheads which served still further to subdivide the transverse compartments.

Unfortunately, this great ship was ahead of passenger and freight traffic requirements of her day; she could not get a sufficiently large passenger list nor sufficient freight to make her a paying proposition. There was a return to smaller ships; but most unfortunately for the safety of ocean travel, the ocean liners, built from her day on, were constructed without that proper and very solicitous care which Brunel exercised in the endeavor to make this ship safe and practically unsinkable. That Brunel was satisfied that he had succeeded in building a safe ship is shown by his "notes on the strength and safety of the 'Great Eastern,'" which he prepared for the stockholders and directors just before her launching, in which he said, "No combination of circumstances, within the ordinary range of probability, can cause such damage as to sink her."

In the forty years of shipbuilding succeeding the day of the "Great Eastern," the shipbuilder eliminated many of the structural elements which made that fine ship so safe. The double hull was confined to the bottom of the ship, the sides, from the turn of the bilge up, consisting merely of a single thickness of plating. The longitudinal bulkheads were omitted, as were also the watertight decks.

Now, so far as the saving of the lives of the passengers is concerned, the double bottom is not so important as the double sides. As a rule, in case of puncture of the outer shell through running upon rocks, the ship remains afloat and the passengers can be saved; but in the event of a rupture, as in the case of the "Titanic," of the single shell plating at the sides of the ship, experience shows that if the damage be extensive, the ship is doomed.

As matters stand to-day, only a few of the large ocean liners engaged in the Atlantic trade embody the principles of safety which Brunel put into the "Great Eastern." The "Kaiser Wilhelm der Grosse" and the "Cecilie," of the North German Lloyd, are so built, as are also the "Imperator" and the "Vaterland" of the Hamburg-American Line. The "Olympic," after the disaster to the "Titanic," was rebuilt at a cost of a million dollars, and she now carries an inner skin, lofty bulkheads, and watertight flats below the water-line. She is now a safe ship. The "Mauretania," "Lusitania," and the new "Aquitania" of the Cunard Line are safe; for they too have been provided with an inner skin in the shape of the inner walls of the coal bunkers, which extend throughout the greater portion of the length of the ship. The new "Britannic," due here in the Autumn, will carry an inner skin. Outside of these ships and perhaps a few others, practically the whole of the fast and large passenger-carrying ships on the Atlantic and Pacific Oceans are without an inner skin, and in case of serious collision, are liable to suffer the same fate as the "Empress of Ireland."

In our last issue we drew attention to the very serious fact that, although the recent London International Conference on Safety at Sea advocated higher transverse bulkheads terminating in a watertight deck, it did not, as it should have done, specifically call for the provision of some form of inner skin. We consider that it is a great misfortune that this distinguished board was not composed more fully of purely technical men—naval architects and engineers—who would have considered the question of making ships absolutely safe upon its technical merits and without a too tender regard for the first cost of construction. It is not too late to make the necessary change before the Convention is ratified. The cost of inner-skin construction is not prohibitive by any means, and if it will prevent, as it certainly will, such sudden and wholesale snuffing out of the lives of passengers as occurred in the "Empress of Ireland," considerations of humanity demand that inner-skin construction, in some form or other, should be made absolutely obligatory in the case of ships that carry large passenger lists.

Where the lives of a whole townful of people are concerned, the ships that carry them should be made fool-proof. This can be done; for it is a mere matter of mechanics and construction. Certain it is that the human element and all the risks which come with it can never be eliminated. When two ships, such as the "Empress of Ireland" and the "Storstad," which sight each other some two miles apart, and are in constant conversation during a passing fog-cloud, through well understood signals, nevertheless blunder into an inexcusable collision, surely it is time for the public to demand that the ships in which they trust their lives shall be made fool-proof. Throughout the whole of the official investigations which will be made of this terrible calamity, for Heaven's sake, let everybody, from Lord Mersey down, bear in mind the fact that the great lesson of the calamity is that we must safeguard against the frailty of the human element by making such horrors as this *mechanically* impossible.

Lightning Protection for Dwellings

EVER since Benjamin Franklin invented the lightning-rod our ideas as to what constitutes effective protection for buildings have undergone constant revision. The cheap and improperly installed lightning-rods sold to farmers by enterprising agents were soon found to be worse than useless, and, in the reaction that set in against them, the modern dwelling house has usually been left without any protection. This has developed a situation that is both critical and serious, because we are now building our houses in such a way as greatly to increase the hazard that existed heretofore.

The modern skyscraper seems to have worked out its own salvation, because it is constructed on correct principles. Its massive steel frame, its metallic roof, and its grounded conductors form a lightning protection that is as perfect as could be desired.

In the modern suburban house, on the other hand, we are persistently violating the principles that have made the skyscraper so safe, and the increased damage that has resulted abundantly testifies that we are paying the penalty for such infraction of Nature's laws. Houses of the class mentioned are seldom provided with metallic roofs. Shingles, slates, and asbestos shingles are the predominating materials, and the leader pipes frequently terminate several inches above the ground. These things in themselves, however, do not constitute the increased hazard to which reference has been made. This comes from the steam or hot-water heating system, where we construct within the shell of the building a system of massive conductors running from cellar to attic. These pipes are, for the most part, very straight, forming paths of low impedance to the passage of high-frequency discharges, and they are also directly connected to the underground piping of the water-works system, which forms a most effective "capacity ground." A more attractive path for a lightning discharge it would be difficult to imagine, and yet how can the lightning take advantage of it? *Only by puncturing the roof or side-walls of the building and probably setting them on fire!*

The writer has seen so many buildings damaged in just this way that he is moved to point out the danger, and to suggest as a remedy that such a heating system should be provided with at least one or, preferably, several pieces of pipe extending from the top-floor radiators straight up through the roof and terminating with capped ends. It would seem, from careful consideration of the various factors involved, that the danger will, by this expedient, be greatly lessened.

Climatic Fluctuations

THE study of real or supposed changes and oscillations in climate possesses a peculiar fascination for many minds, if one may judge by the flood of literature that has appeared on this subject. The idea that the climate of any region has definitely and permanently changed within a generation or so, although firmly fixed in the mind of the average layman, is not held in honor in scientific circles. On the other hand, few meteorologists have been able to resist the temptation to hunt for periodicities, correlations, and the like, in the ups and downs of climatic curves from year to year, and to seek the clue to these fluctuations in such far-reaching agencies as variations in solar radiation, volcanic eruptions, or what not. Such investigations, however, are often vitiated by hasty assumptions from the records of a limited number of stations as to what has occurred in the world as a whole. In order to know, for example, whether world-temperatures fluctuate in the same way as the sunspot period, we must have before us some accurate delineation of these temperatures which will not obscure the fact that a warm year in Europe may coincide with a cold year in South America, and so forth. It probably never happens that the temperature of the whole world is above normal at the same time; what we have to deal with, in investigating world-temperatures, is variations in the size and intensity of the regions in which excessive temperatures *do* occur. These are what Mr. Henryk Arctowski has called "pleions," and his method of charting the pleions of temperature and other elements from year to year is one of the most fruitful devices known to meteorology. First set forth in his "Enchaînement des variations climatiques" (Brussels, 1909), it has been utilized in this author's numerous contributions to the *Bulletin of the American Geographical Society* and other journals. His latest study of "pleionian" variations appears in the *American Journal of Science* for April, 1914.

Temperatures of the Stars

DURING two years, Rosenberg has studied photographically the spectra of the seventy most brilliant stars in the northern hemisphere, from the first to the third order of magnitude. By a comparison of their spectra it is possible to deduce their temperatures. The results obtained agree well with those of Wilsing and Scheiner; stars of the helium type are the hottest, and the red stars are the coolest. As a specimen, the following temperatures are quoted: Sirius, 27,000 degrees; Vega, 22,000 degrees; Algol, 12,000 degrees; Arcturus, 3,000 degrees; Aldebaran, 2,000 degrees.

From the aspect and relative displacement of the spectral lines an idea may be formed of the pressure conditions in the atmospheres of the stars studied. Thus Adams has found that in the light-emitting atmosphere of Sirius the pressure is twelve times that existing in the solar photosphere, which confirms the hypothesis that Sirius is a simple mass of gas, without a defined surface of condensation.

William A. Carroll

IT is with much regret that we announce the death of Mr. W. A. Carroll, who, for many years, was connected with the advertising department of the SCIENTIFIC AMERICAN as its Western representative, which field he covered in a most satisfactory manner, making for himself a high record of efficiency in this work. His close attention to business, genial manners, and good-fellowship gained for him a host of friends in the West, who will, we are sure, regret with us his untimely demise.

Engineering

Proposed Inter-terminal Line at St. Petersburg.—According to the *Engineer*, it is proposed to construct a belt line of railway connecting up the various lines entering the city of St. Petersburg. The line will serve for the transfer of merchandise and passengers from one railroad system to another, and the total length will be about 63 miles.

High Speed on a Maiden Trip.—During her maiden trip to this port last week, the new Cunard steamship "Aquitania" steamed during a single day 602 miles, an average of 24.24 knots. On her trial trip she averaged for a few miles slightly over 25 knots. The fastest average for the whole Atlantic trip of 26.06 knots was made a few years ago by the "Mauretania."

President Wilson on the Merchant Marine.—After a call of the National Foreign Trade Convention at the White House the President was quoted as saying: "I am sure that I speak the conviction of all of you when I say that one of our chief needs is to have a merchant marine. Because we have to deliver our goods in other peoples' delivery wagons their goods are delivered first and our goods are delivered incidentally on their route."

Railway Accident Statistics for Three Months.—During the three months ending September 30th, the Interstate Commerce Commission states that 211 passengers were killed and 4,011 injured in train accidents in the United States. At this rate the total for the year would be 844 killed and over 16,000 injured. The accident *Bulletin* says that 67.6 per cent of the derailments were due to defective equipment and defective roadbed.

The Spaciousness of Modern Liners.—As showing the spaciousness of the largest of the modern ocean liners, attention is drawn to the ballroom on the "Vaterland," which is 80 feet in length, 58 feet in width and 21½ feet in clear height. In spite of its great span, this room has no supporting columns whatsoever, the roof being carried by overhead girders, extending from side wall to side wall. The dining-room is 135 feet long, upward of 100 feet in width, and it has a maximum height of 30 feet.

Cost of Panama Canal in Lives.—In a letter to Hon. George M. Young, Representative in Congress, Col. Goethals states that from May, 1904, to March, 1914, 1,219 lives were lost on the Panama Canal through accidents. This total covers only those deaths which resulted from accidents happening on the work, except that it includes 167 deaths from accidental drowning, all of which did not occur on the work. From August, 1908, to March, 1914, the accidents resulting in injuries reached a total of 25,101. Mr. Young called the attention of Congress to the fact that the loss of life through accidents, as here recorded, was greater than that during the war of 1812, or during the Mexican war.

A Difficult Engineering Feat.—What is considered one of the most difficult bridge engineering feats yet attempted was the removal from the Williamsburg Bridge trusses of the existing end pins and the substitution of larger pins, without seriously interfering with the traffic. For some time reconstruction of the floor system of the bridge has been under way, in preparation for the heavy subway trains of the Dual Subway System. As part of this work it was necessary to remove the existing 10-inch pins from the trusses at the towers and substitute 13-inch pins of nickel steel. These pins are 40 inches in length and weigh 1,500 pounds. It was necessary to drill out the ends of the steel girders to the enlarged dimensions before inserting the pins.

The Hydro-Aeroplane at Vera Cruz.—Capt. Washington I. Chambers, U. S. N., in a lecture to the members of the University Club of Washington, stated that the hydro-aeroplanes had proved their usefulness in military operations around Vera Cruz and elsewhere. Particularly had they shown their value in ascertaining whether or not harbors were mined. The captain stated that not only is it possible to see mines plainly, but they can be easily photographed from the aeroplane. Recently, mines were planted on the Pacific Coast and the commander of the Pacific fleet was notified to that effect. The aeroplanes were sent out to search for them, the aeronauts having no information as to the vicinity in which they could be found. Nevertheless, they had no difficulty in locating the mines.

A Suggestion in Economy.—According to the *Railway Gazette*, an American railroad recently sent a train over its system to collect scrap material and odds and ends of every kind, the train carrying a divisional superintendent and his staff. Scrap and obsolete material was collected to the amount of 147 car loads, valued at $42,000, and after deducting the cost of labor, train expenses, etc., there was a net gain of $39,000. As showing the conditions, twelve bottles of ink were found at a small station where one bottle would suffice for a year, and at another point fifty non-insulated bridle rods were found at a station on territory which was track-circuited throughout. Useless at such points, these materials were serviceable elsewhere.

Science

Dr. Richard Assmann, the dean of German aerologists, has retired from the directorship of the aeronautical observatory at Lindenberg, where he is succeeded by Prof. Hergesell, late of Strassburg.

The Edward Longstreth Medal of the Franklin Institute has been awarded to Prof. William J. Humphreys of the United States Weather Bureau, for his paper on "Volcanic Dust and Other Factors in the Production of Climatic Changes and Their Possible Relation to Ice Ages."

Coins for a Leper Colony.—The Philippine government has minted a special coinage for use in the Culion leper colony. The coins are of aluminium, and include pieces of one peso, and twenty, ten, five, one and one half centavos. They are accepted at face value for all business carried on within the colony, but are of no value elsewhere.

An Encyclopædia of the German Colonies is in course of preparation under the general editorship of Dr. H. Schnee, governor of German East Africa, and is to be published in Leipzig. About seventy specialists will contribute articles on colonial politics, geography, ethnology, geology, mineralogy, zoology, mining, agriculture, communications, missions and all other topics connected with Germany's great colonial empire.

Agricultural Meteorology in France.—The project of establishing an office under the French government devoted to the study of agricultural meteorology (distinct from the Bureau Central Météorologique) has been under discussion for several years. A technical commission on this subject has at last been established by a ministerial decree of January 6, 1914, as a branch of the Direction Générale des Eaux et Forêts, under the Ministry of Agriculture. It consists of thirty members, who are nominated for three years.

A Daily Wireless Weather Bulletin for the Great Lakes was inaugurated by the United States Weather Bureau on June 1st. It is distributed broadcast by the naval radio station at Radio, Va., a few minutes after 10 P. M., immediately after the bulletin for the North Atlantic and Gulf of Mexico, which has now been sent out daily for some months. The new bulletin, which is for the benefit of mariners on the lakes, gives the weather conditions prevailing at 8 P. M. of the current day at Duluth, Marquette, Sault Ste. Marie, Green Bay, Chicago, Alpena, Detroit, Cleveland and Buffalo, and a forecast of wind and weather conditions for the upper and lower lake regions for the following 24 hours.

An International Hydrographic Campaign in the North Atlantic Ocean is planned in connection with the formal opening of the Panama Canal. At the suggestion of Prof. Schott of the Deutsche Seewarte, all European countries that are to send men-of-war to Panama for the opening ceremonies have been asked to make a complete hydrographic cross-section of the ocean along their routes. According to this programme, three professional oceanographers would be carried on each of the ships, and the ordinary time of crossing would be increased by about a week to enable the work to be thoroughly carried out. The Prince of Monaco has been asked to take part in the campaign.

The Effects of Smoke on Cattle were the subject of an inquiry addressed to farmers in the vicinity of Leeds, in connection with the investigations being carried out at Leeds University concerning the effects of atmospheric pollution on vegetation. It was learned that the effects of a smoky atmosphere on both cattle and horses are marked; young stock do not thrive, while older animals require more food and greater care than those living in a less contaminated atmosphere. The effects are partly due to the respiration of the smoke-laden air, and partly to the inferior quality of the grass growing under such conditions. The raising of sheep is even more difficult, because of the depreciation in value of the wool due to the smoke, and is rarely attempted near Leeds.

Freezing a Patient to Cure Him of Consumption.—Freezing of living persons is the somewhat heroic remedy proposed by the Russian scientist Bachmetieff, for the Koch bacillus is killed at 6 deg. Cent. below freezing point, it being the cause of tuberculosis, so that by congealing the person affected with the disease the microbes are all killed. Then he brings back the subject to life by a very gradual re-heating. He has already succeeded in applying his method to various animals such as the rat and others by producing artificial respiration in them at the same time that the freezing process is going on, and he thus produces suspension of life by cold which is of great interest to science and may also prove of much utility. Freezing of cattle in Winter would thus preserve them without food, and they could also be transported over great distances when in this state. Many other applications of the idea can be imagined. Of course, the method has not as yet been applied to the larger animals nor to living persons, but in principle this does not appear to be impossible, and it now remains to be proved whether a human being can be actually frozen and then brought back to life.

Aeronautics

The Trial of the Langley Aerodrome.—Our correspondent at Hammondsport informs us that the flights of the old Langley machine have thus far been brief—hardly less than ten seconds. Hence they are not conclusive. Mr. Glenn H. Curtiss has about decided to substitute a more powerful engine—probably his eight-cylinder—and a single-tractor screw, since the present plant has not quite thrust enough for forty per cent extra weight due to floats and the trussing between them and the steel frame. The present arrangement has about twice the resistance of the original machine.

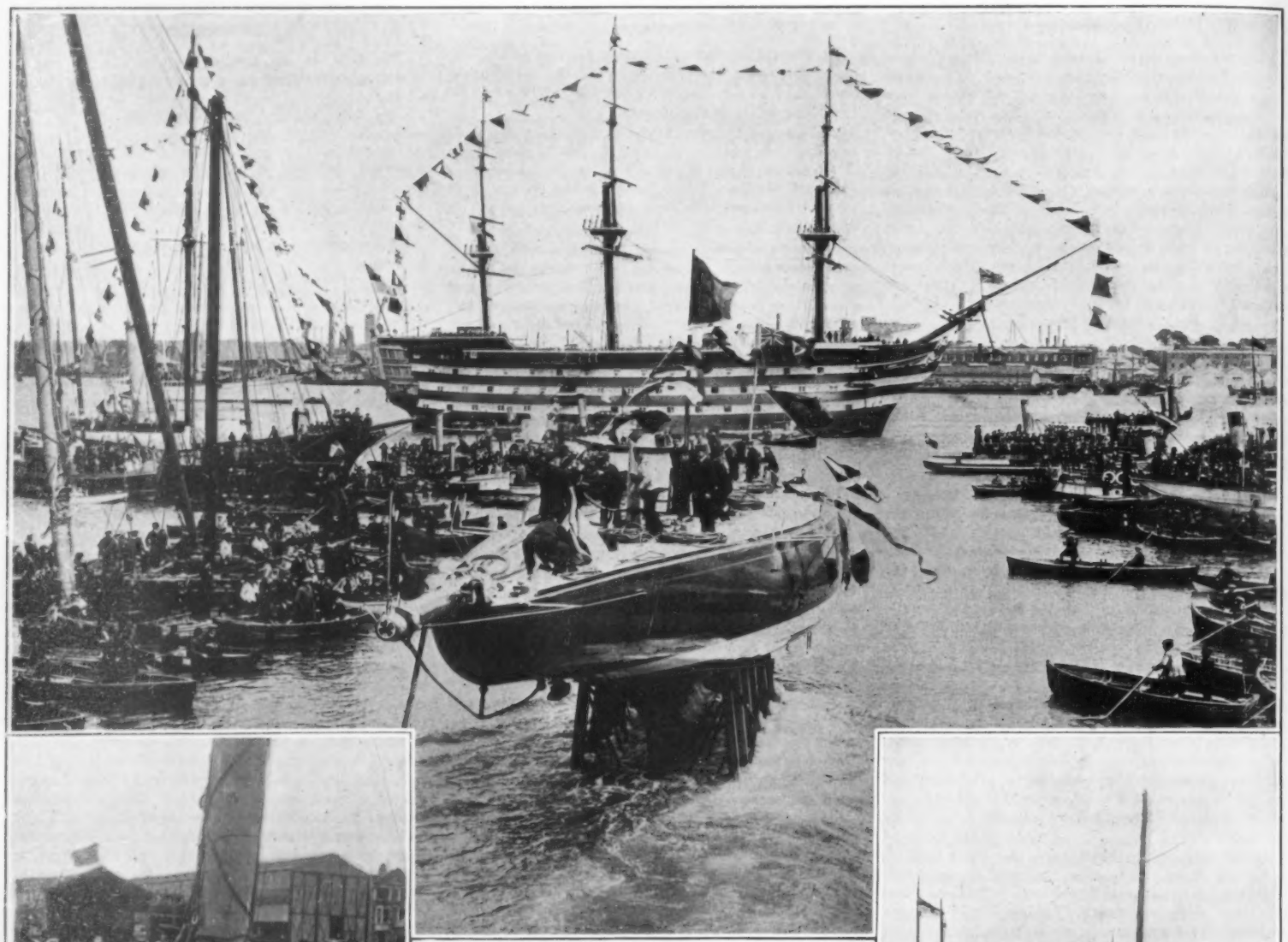
Pending Legislation for Army Aviation.—The passage by the House of Representatives of the Hay Bill looking to the establishment of a division relating to flying in the office of the Signal Corps encourages army officers because of what might be termed the official status thus given to aviation in the military establishment, especially as there is much hope for favorable action by the Senate on the bill.

American Hydro-Aeroplanes Abroad.—Philip Hoffman, the Secretary of Embassy at Constantinople, reports that the Ottoman Ministry of Marine has recently had under consideration the desirability of purchasing one or more hydro-aeroplanes or flying boats, one of which, under American auspices, has lately made several private trial flights near Constantinople with success, and it is reported that successful trials have also taken place in Russia.

Aeroplane Racing.—According to the ideas of Mr. Paris Singer, one of the prominent Englishmen living in the Riviera, the time-honored horse race will be supplanted by the aeroplane race. Each proprietor will own a number of aeroplanes and have one or more pilots in his employ, and racing events will be held under the same conditions as for horse races, and no doubt with more excitement. To start the movement, which would be more of a success in the Riviera than elsewhere, owing to the favorable climate, he has now engaged the crack pilot, Maicon, and will purchase several fliers. Maicon will act as chief and will train other pilots if need be. Should others take up this idea, each proprietor will have his fleet, and there would be organized suitable racing events between them; or, on the other hand, the fliers will be sent to take part in various official contests. He expects to use watercraft largely for sailing upon the Mediterranean.

Germany's Air Strength.—It appears that Germany now has 14 large airships, including 7 Zeppelin destroyers. Their size is on the average 600,000 cubic feet, and they carry 600 to 800 horse-power motors. A crew of 15 to 20 men is carried, also 8 tons net load, comprising 1.5 tons of projectiles. As regards secondary questions, these are now very well organized. Between Berlin and the frontier are thirty balloon sheds and grounds with sheds of 600 feet length in many cases, pivoting upon large platforms so as to face the wind and allow the airships to enter safely. Balloon supplies are well looked after, and special railroad cars are fitted out with sets of steel hydrogen bottles mounted upon a common discharge pipe. Such cars are kept stationed in works which furnish hydrogen as a by-product, and are ready to be sent out upon the railroad wherever they are needed. The German army counts considerably upon night trips with the airship or aeroplane fleet, and all the needed measures have been taken to allow of doing this in good condition, the landing grounds being lighted at night and a system of colored electric flashes, as in lighthouses, shows special signals for each of the grounds. A powerful electric searchlight on board the airship also lights up the ground when landing.

The Third Russian Aeronautic Congress.—An interesting event was the third Russian Aeronautic Congress held at St. Petersburg. Numerous papers were read. In the military section we note the communications made by Lieut. Iatsouk upon rational training of army and navy pilots, and a paper by Gen. Kaulbars upon the necessity of different types of aeroplane. Col. Gatovsky presented a memoir on organization of the aerial fleet. The technical section had papers on the state of aviation at the present time, aerial propellers and the work of the Technological Institute aero-dynamic laboratory. Prof. Renine treated of wind pressures on various surfaces, and Prof. Sarkovsky of aero-dynamic comparisons among aeroplanes. In the section which concerns general and sporting questions, M. Chetamine read a paper on the situation of the aeronautic industry in Russia and other countries, and upon organizing of aerial militia. This last topic was taken up and completed by the Aero Club Secretary Weigueline in his paper on private aeroplanes in connection with military use. A leading paper of the congress was the report made by Engineer Berk upon use of railroads for organizing observations on the passage of aeroplanes and installing of landing places. It is thought that the present congress will be the starting point of a considerable development of aviation in Russia, especially as concerns military questions.

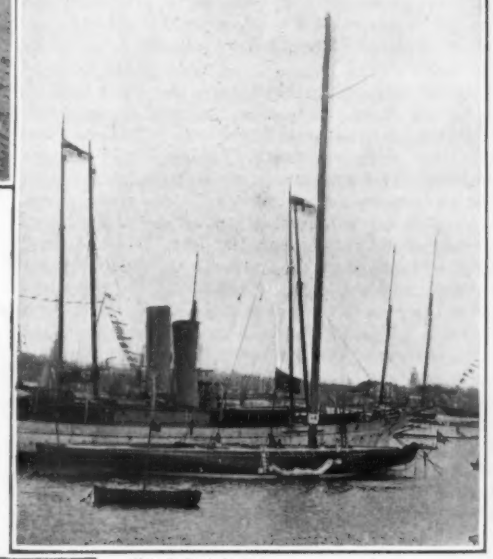


Photo, by Topical Press Agency.

Launch of "Shamrock IV." Nelson's "Victory" in distance.

Photo, by Topical Press Agency.

Stepping the mast in "Shamrock."



Photo, by Cribb, Southsea.

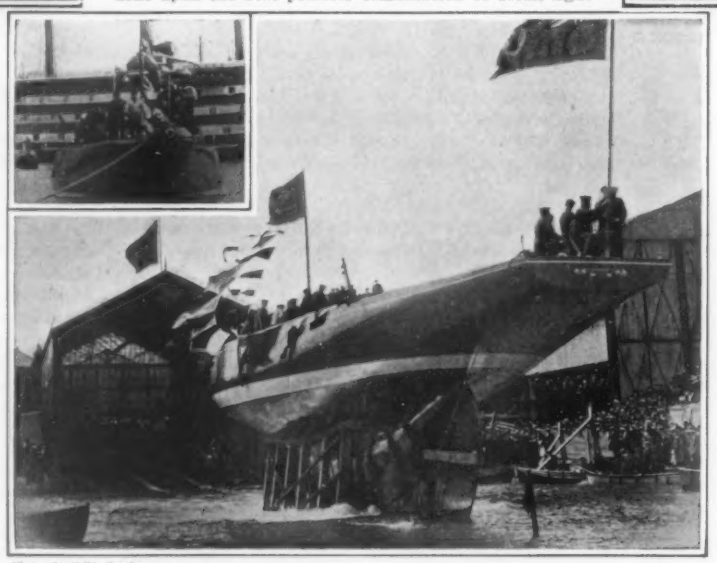
Note the lofty mast stepped far forward.

The Launch of "Shamrock IV"

A Yacht Designed on Strictly Utilitarian Lines

OF great interest to American readers will be the photographic views which we publish of "Shamrock IV." The first impression one gains from the pictures is that designer Nicholson, realizing how closely contested are the present-day races for the "America's" Cup, determined to design his yacht along lines of the strictest utility. During the process of planning a purely racing yacht, such as "Shamrock IV," in which the question of ultimate speed is dependent upon the best possible combination of form, lightness, and strength, occasions will arise when beauty must be sacrificed to utility, or, to put it in another way, when the artist in the naval architect will demand one thing and the engineer in him will demand another. Evidently designer Nicholson decided that the only possible chance to win the "America's" Cup was to build his yacht with exclusive regard for speed.

This line of thought reminds us of something that happened when we were watching the "Resolute" and "Vanitie" in their first trial race. A marine artist who was discussing the yachts said to the writer: "'Billy' Gardner is too much of an artist for his own good. 'Vanitie' is surely the sweetest thing that ever sat upon the water; but if Gardner had been willing to cut 5 feet off that beautiful tapering stern and another 5 feet off her long, keen bow, he would have saved sufficient weight on 'Vanitie' to gain several seconds of time in a 30-mile race." Nicholson has cut off the 10 feet of tapering grace and elegance; for his "Shamrock" is only 110 feet on deck, as compared with the 120 feet of the "Vanitie." Further evidence of weight-saving is seen in the considerable "tumble-home" of "Shamrock." She is broadest at the waterline, say about 23 feet, and cannot be more than about 20 feet in breadth at the deck. This means an additional saving in weight, because of the shorter deck beams and the reduced area of deck surface. True, this weight which is saved in the deck and put into the lead bulb is gained at some expense of beam; but as a compensation for this there is the fact that, when the yacht is heeled until her rail is awash, she is sailing upon easier lines.



Photos, by Cribb, Southsea.

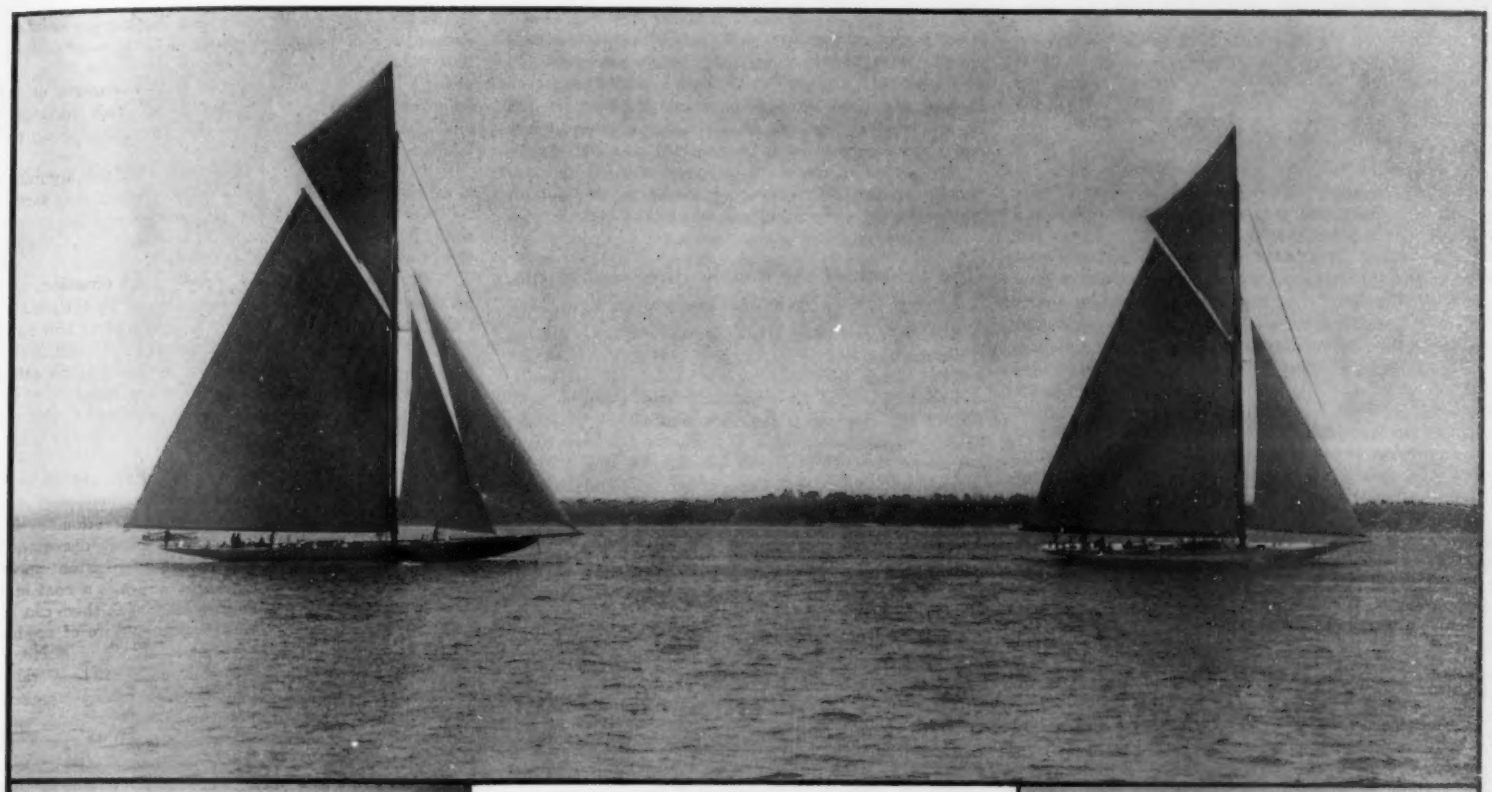
Note the tumble-home, giving easy sailing lines when heeled.

Nicholson appears to have been willing to disregard the quarter-beam penalty, believing that the fuller waterlines, forward and aft, will give a sail-carrying capacity which will more than compensate for the penalties imposed. Judging from the photographs, the form of "Shamrock" appears to be a compromise between "Shamrock III" and "Reliance."

The construction of the yacht is very light, consisting of web framing, overlaid by a skin made up of three thicknesses of planking. The two skins next the framing are laid diagonally to give longitudinal stiffness, the outer layer being laid horizontally. The deck is exceedingly light, consisting of several layers of birch veneer, totaling less than an inch in thickness. A peculiarity in the outboard profile of the yacht, due to the persistent effort to save weight, is the fact that the sheer line drops somewhat, from amidships toward the bow—a change which will result in a not inconsiderable saving of weight in the forward portion of the hull.

The sail plan of "Shamrock IV" is similar to that of our own "Defiance." The mast is set far forward and the yacht carries a single head sail, the foot of which is laced to a boom, as in the case of "Resolute." The mast is so far forward,

(Concluded on page 493.)



"Resolute" and "Vanitie" close-hauled on the port tack.

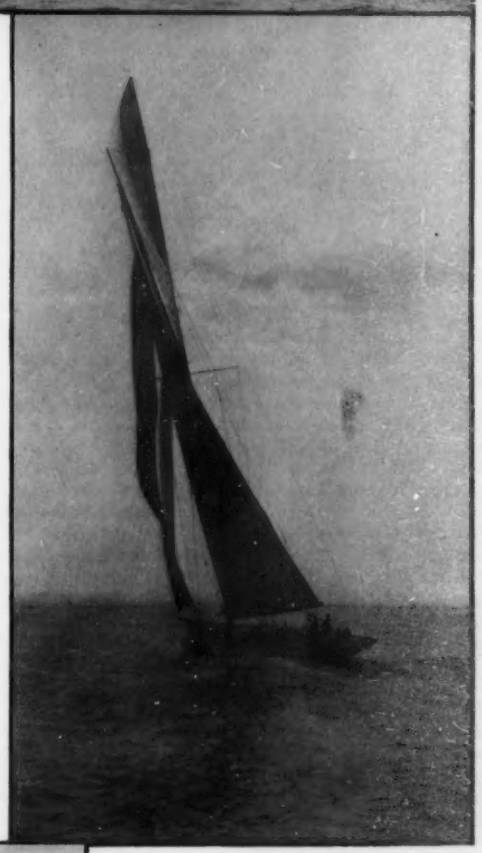
Trial Races of the Cup Defenders

Promise of a Close Contest Between the Defending Yachts for First Position

WITH three yachts available for the defense of the "America's" Cup, the Cup Committee is going to make sure there is no mistake about the selection of the absolutely best of the three to meet the challenging vessel. No less than thirty-five contests will be held before a final choice is made. Of these, including those which have already taken place, twelve will be held in Long Island Sound; eleven will be sailed off Newport; three will be sailed on June 10th, 11th, and 12th off Sandy Hook; and during the New York Yacht Club's cruise in August, there will be a week of cup trials. These races will provide an opportunity for the Cup Committee to observe the three defending yachts under all possible conditions of weather, from drifting matches to those sailed in a stiff blow.

The first meeting of the yachts took place on June 2d over a triangular course off Great Captain Island, Long Island Sound. The "Defiance" was absent, for the reason that she was at City Island having a very considerable reduction made in her sail plan. In her preliminary tests the "Defiance" proved to be unable to carry her towering rig, heeling down under a breeze of moderate strength until her lee rail was far under water. Her mast is being shortened about nine feet; two feet are being taken off the main boom and something from the gaff, and it is hoped that with these changes the boat will be better in hand. We are not surprised that these defects developed. A reference to the plans which we published of the yachts on May 2d will show that the center of gravity of her lead is high relatively

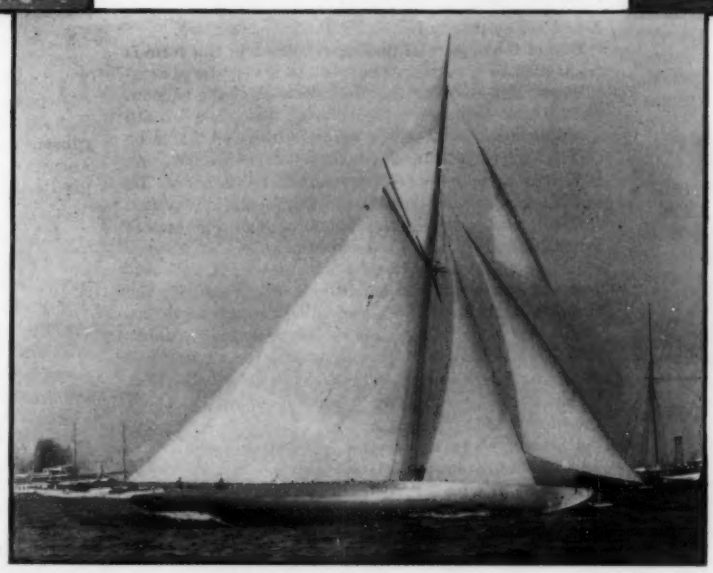
"Vanitie."



"Resolute."

to the other two yachts. Furthermore, her keel is much shorter; in fact, in this respect she reminds one somewhat of "Independence," and, like "Independence," she has proved to be a difficult boat to hold on a true course. It is sincerely to be hoped that, after the changes are made, the "Defiance" will find herself, and that her owners will have the gratification of seeing her make a close fight for first honors with the other two yachts.

The first meeting between "Resolute" and "Vanitie," which was witnessed by the writer, verified the predictions which we made in our article published in the issue of May 2d. Whenever the course lay to windward and the sheets were flattened in, the Herreshoff boat pulled away from "Vanitie," particularly when the wind lightened. As soon as sheets were eased, the "Vanitie," with her long, easy sailing lines, proved to be the faster boat. On the first day the wind was very fluky, and to the skill of "Vanitie's" skipper in



"Vanitie" with her lee rail awash.

what is known as "wind hunting" must be attributed a large part of the handsome margin of 16 minutes and 48 seconds by which "Vanitie" won the race. From this must be deducted 3¼ minutes, the time that the "Vanitie" had to allow to the smaller boat.

In the second race, sailed June 3d, there was a good sailing breeze throughout the race, and neither boat was particularly favored. Here again the "Resolute" showed her superiority in windward work, and "Vanitie" proved the faster on a reach. The boats finished with only 11 seconds difference between them. "Resolute" got away 12 seconds ahead of "Vanitie" and finished 11 seconds ahead, which with her time allowance of 3¼ minutes gave her an advantage of about 3 minutes and 26 seconds over the Gardner boat. The superior work of "Resolute" to windward was shown by the time at the first mark, which "Resolute" turned at 1:9:57 and "Vanitie" at 1:11:59, or 2 minutes

and 2 seconds later. In the broad reach home, "Vanitie" showed her reaching ability by cutting down the lead of "Resolute" to 54 seconds only. Going to windward over the 7½ miles on the second round, the yachts were practically even, and in the last home-stretch of reaching "Vanitie" gained 31 seconds on "Resolute."

In comparing the two yachts it must be borne in mind that "Resolute" had had about one month of tuning up. Her sails were well stretched and their set was perfection. "Vanitie," on the other hand, had been out for only two or three short sail-stretching spins, and it was evident that her sails were in no such condition as those of "Resolute." As the various races take place, each will steadily improve, particularly in windward work. At the present writing, it looks as though "Vanitie" might be able, when she has thoroughly found herself, to save the 3¼-minute time allowance, with sufficient in hand to make her a winner by a slight margin. In any case, the races between these two yachts promise to be the most close and interesting that have ever occurred in the history of "America's" Cup defense.

An interesting feature in "Vanitie" is the fact that she is a model-basin yacht, several thousands of dollars having been spent in testing various models in the naval towing tank at Washington before the present form was decided upon. In this connection it is of interest to remember that by far the most successful yacht sent over from the other side, the "Shamrock II," was also a model-tank yacht, Watson, her designer, having spent some nine months in experimental work in the model basin at the Denny yard, Scotland, in developing her form.

The New Wright Flexible Drive

THE new Wright flexible drive as adopted on the new aeroboats and military machines consists of an auxiliary shaft connected at one end to the motor by the shock-absorbing element and at the other end driving the propellers. On the flywheel of the engine there are fixed steel pins, and at the end of the auxiliary drive shaft there is a steel cone with similar pins attached to it. The pins on the flywheel are attached to the pins on the drive shaft cone by a number of shock absorbers. The transmission end of the shaft is supported by a bearing, while the other end of the auxiliary shaft merely rests on the crankshaft of the motor, free to rotate about it, but restrained and held in position by the shock absorbers. There is thus obtained a perfectly flexible unit, the power being transmitted through the shock absorbers. There are eight shock absorbers used in the drive for the six-cylinder Wright engine. Any variations or shocks in the rotation of the motor are taken up by the stretch of these shock absorbers. In a back fire, for example, the motor will stretch the shock absorbers almost a half revolution before effecting the transmission. The amount of spring that can be obtained by this device is very great. It takes up, without damage to the transmission or to the rest of the machine, the most severe vibrations of the engine, at the same time greatly easing up the strains on the engine itself. The additional weight of the drive on the new Wright aeroboat is only about 18 pounds.

In addition to reducing the shocks on the entire machine and greatly eliminating dangers of crystallization of steel parts, the introduction of the flexible drive permits of entire freedom in design with reference to the placing of the engines and propellers. In the case of the Wright aeroboat and the new Wright military machines, it has rendered exceedingly simple and practical the installation of the engine in front of the operators, motor-car fashion, with the propellers in the rear.

This combines the elements of safety due to placing the motor in front, the comfort and efficiency of the propellers at the rear, and (though the seats are back of the engine and slightly back of the edge of the planes) the view for observation is not in any way seriously restricted. The extreme comfort of flying in a machine of this type has been a revelation to those who have had the opportunity of taking trips on these new machines. There is a feeling of security in seeing the motor in front of one, and it is interesting to note that the noise does not seem to be as great as having the motor at one's back, or over one's head.

Important Regulation as to Guaranties Under the Pure Food Law

THE Secretary of the Treasury, of Agriculture, and of Commerce, acting under the authority vested in them by the Food and Drugs Act, looking to the joint making of regulations, on May 5th, 1914, directed that after May 1st, 1915, the regulation No. 9 of the Rules and Regulations under the Food and Drugs Act should be amended in several respects, particularly to the effect that hereafter, that is to say, after May 1st, 1915, no guaranty in any form shall be filed with and no serial number shall hereafter be given to any guaranty by the Secretary of Agriculture, and that all guaranties now on file with the Secretary of Agriculture shall be stricken from the files, and the serial numbers assigned to such guaranties shall be canceled, and that the use on the label or package of any food or drug of any serial number required to be canceled as above is prohibited. This regulation when once effective will materially change the manner of marking merchantable matter coming under the Food and Drugs Act.

The Fallacy of the Double Dirigible Balloon

By R. H. Upson

DOUBLE or multiple balloons have always been an attractive field for experiment, and it is unfortunate for this reason that they have so little practical value. Several balloons of this type have been built, notably that of M. Rose which attracted considerable attention a few years ago, but as far as I can discover, it never made any respectable flights. For all that, there is nothing impossible about such a balloon, but it would be comparatively inefficient, and there seems no more real occasion for one just now than a double boat or catamaran. The latter is sometimes made for a very special reason; so might a double balloon, but it would have to be a very good reason to overcome its many objectionable features.

The principal objections all depend on the following proposition:

If the volume of a single solid be divided up among two or more similar solids there will be more surface in proportion to the volume than before.

When applied to a dirigible balloon, this means that a double balloon of the same volume and gross lift will have more surface, more resistance, more leakage, less speed, will be more easily affected by temperature, will be harder and more expensive to make, and in ordinary cases will be heavier owing to the increased width of the car.

As a numerical example, let us see how much we can improve a medium sized dirigible of 375,000 cubic feet capacity and 200 horse-power by dividing it into two balloons, side by side, of the same length and gross volume. (The balloon is purposely assumed of comparatively low speed to give all the advantage possible to the proposed double construction.)

The longitudinal surface will be multiplied by 2. The weight of the gas bag will remain practically the same, but the weight of the car will be nearly doubled. Assuming the same horse-power and propeller efficiency, we get the following table of comparison:

	Original Dirigible.	Double Balloon.
Head Area	1,900 square feet	1,900 square feet
Longitudinal Area	33,000 square feet	46,700 square feet
Resistance of Gas Bags, at 30 miles per hour	1,050 pounds	1,210 pounds
Resistance of Car, at 30 miles per hour	250 pounds	400 pounds
Speed	30 miles per hour	28 miles per hour
Weight of Bag	4,600 pounds	4,600 pounds
Weight of Car	5,900 pounds	10,000 pounds
Surplus Lift	12,300 pounds	8,200 pounds

It can be seen that we have hurt the balloon in nearly every possible way and have gained practically nothing.

We could have a little more propeller area, but we *need* more with an increased resistance to keep the same efficiency. There would be more room to attach aeroplane surfaces, but we could attach all we would want to use to the original car without sacrificing so much.

It could turn in a little sharper circle, but that is hardly an advantage, especially as it could be effected, if desired, by merely increasing the rudder surface.

One of the objects of making a balloon in this form is frequently to give proper support to a very large aeroplane surface covering the whole bottom of the balloon. Going back to our assumed double balloon, a surface could easily be attached to the bottom which would be 200 feet long by 40 feet wide, or 8,000 square feet. As a Wright aeroplane of 400 square feet lifts about 700 pounds at the same speed, one might think that this surface would give a lift of 14,000 pounds, but such is far from the case. There are several things which very much lower its efficiency. It is flat, it is long in the direction of motion, and the big balloons interfere with the free flow of air around it. Neglecting the last consideration, the reaction on such a surface is expressed fairly well by Newton's old formula which, for an angle of 10 degrees, gives a lift of 680 pounds, or *actually less* than the small but properly proportioned aeroplane, at about the same angle.

It might be said that this formula assumes an infinitely long plane, but all things considered, the result is probably not far from correct. If we take 800 pounds as a fair estimate, we get 0.1 pound per square foot of surface, not even enough to lift its own weight. This almost inconceivable difference is not only a theoretical deduction, but it has plenty of experimental proof.

The following argument is sometimes used for a flat or multiple balloon: "An aeroplane has a very small resistance in a direction perpendicular to its course; hence it is not very easily blown out of its course by a side wind; but the ordinary dirigible is at the mercy of the winds on account of its large side area. This side resistance could be very much cut down by multiplying the balloons laterally."

A little thought will at once show that this argument is entirely fallacious. I won't try to prove it here except by saying that if such an argument could be proven sound, then perpetual motion is a *realized fact*. Here is the proposition, and I can't state it too strongly.

Given a wind of uniform velocity and direction, and an airship of any kind suspended in and by the air and using the air for propulsion. Then no matter how hard the wind blows or what the form of the airship is, it can go *through the air* (not over the ground) in no other direction and at no other speed than that determined by its own power. That is, in a given wind of uniform velocity the question of dirigibility is merely one of speed, *and absolutely nothing else*.

The numerous gusts and eddies in an actual wind affect the stability of an aeroplane very seriously but do not materially affect its direction of motion. With a dirigible, the effect of gusts may be totally disregarded for most purposes, and the problem of resultant speed becomes merely one of relative motion like a boat in a moving stream. To a person in free flight there can be no wind from the side except in the nature of sudden gusts.

A low side resistance might seem to be of considerable value when using a drag rope, water brake, etc., and more especially to lower the wind pressure when moored to the ground; but here again the result is out of all proportion to the cost of attaining it.

We now come to a possible use for the double balloon which does not apply to present sizes, but which is nevertheless real, and would be well worth investigating for extremely large sizes.

Consider the fabric above the suspension as made up of two parts or layers, one to resist internal compression, and the balance to carry the weight. Call these *A* and *B*. For equal strength and speed, the weight of *A* per square foot will vary just a little more than as the diameter of the balloon, so that for similar balloons the total weight of *A* is nearly proportional to the total volume or lift. The case of *B* is different. It has to sustain a weight, per foot of length, which is very nearly proportional to the area of the section or to the square of the diameter. Hence its weight per square foot will vary as the square of the linear dimensions and its total weight as the fourth power of the dimensions (for similar balloons). As the lift only increases as the cube, a point will evidently be reached when the weight of the gas bag will be excessive compared to the lift. It then becomes necessary to change the design so as to shorten the length of the fabric passing over the balloon.

This could be easily done by making the balloon double. But it would not be of advantage until the balloon was well over 1,000 feet long; and even then, it is probable that a better solution would be found in the rigid type as developed by Count Zeppelin.

Inventor of the Tabulator Typewriter

SOME time ago it was stated in the SCIENTIFIC AMERICAN that H. S. McCormack was the inventor of the tabulator typewriter. We are indebted to the Underwood Typewriter Company for copies of the decisions of both the lower and higher United States courts in the State of New York, in which decision it is held that Josiah B. Gathright was the first inventor of the typewriter tabulator.

The Death of Dr. Von Mauser

DR. PAUL VON MAUSER, inventor of the well-known rifle that bears his name, died in Berlin on May 29th at the age of 76. He began life as an humble gunsmith. He is said to have been financed by an American named Norris. His rifle was later adopted by the German army and several European armies.

The Current Supplement

IN this week's issue, No. 2006, of the SUPPLEMENT, Dr. E. F. Roeber's presidential address before the American Electrochemical Society is published. Its subject is "Some Economic and Æsthetic Aspects of Electrochemistry."—Prof. Kollmann shows how facial features are reconstructed with scientific accuracy from a human skull.—H. O. Swoboda writes on electric safety lamps for miners.—Dr. Glazebrook's paper on the development of the aeroplane is concluded in this issue.—E. Marriage, in an article illustrated with microphotographs, writes on the difficulties of detecting adulterations in fruit preserves.—Frank C. Perkins describes several types of electric cold saws.—Dr. Eccles's article on recent patents in radiotelegraphy and radiotelephony is concluded in this issue.

The Life Story of an Atom

By John W. N. Sullivan

THERE has always been something paradoxical about the notion of an atom. When we are told that matter is built up of a number of tiny little particles, which are themselves incapable of division, we grow perplexed. However small the ultimate particles of matter may be, they must have a certain size; and that being so, it is not at all clear why they cannot themselves be subdivided to an indefinite extent. As a philosophic theory, the atomic idea is most unsatisfactory. It is only when it is considered merely as a useful working hypothesis in scientific investigation that it has any value. Atoms are indivisible in the sense that an atom of any element is the smallest part of that element which takes part in any chemical reaction. Provided that we regard an atom in this light, it is a perfectly legitimate conception.

Lucretius, the old Latin poet, held an atomic theory of the universe, a theory which he enshrined in immortal verse. And although, philosophically considered, an atomic theory plunges us into difficulties, yet our imagination is equally baffled if we try to do without it. If we try to regard matter as perfectly continuous, i. e., as capable of infinite subdivision, we shall find it quite impossible. This dilemma has led to all sorts of queer theories, but we shall see that the modern scientific theory of matter is a peculiar compound of both views.

The modern theory is the outcome of the startling discovery that the atom is by no means indivisible, even in practice. It has been shown experimentally that the old chemical atom is built up of a number of much smaller particles, and we shall see that there is good reason to believe that these very small particles are really indivisible, in the sense that if they were divided they would also be annihilated in the process. These very small particles are called electrons, and they were first discovered in the course of experiments made on the electric discharge in vacuum tubes. It is well known that if we try to make a current pass between two conductors which are separated by an air space we have to use a very high potential and the current passes in the form of a spark. If, however, we put our two conductors in a tube from which the air has been almost completely exhausted, we get some very extraordinary results. Close to one of the conductors we get a blue glow, succeeded by a dark space, which in turn is succeeded by another luminous region. But besides these appearances, and crossing over them as though regardless of their presence, is a shaft of bluish light, which proceeds in straight lines from the surface of the conductor. If the conductor has a concave shape this shaft of light may be concentrated to a focus; and if a piece of platinum be placed at the focus it will be rendered incandescent. When the stream strikes the walls of the vessel or a solid obstacle within it, we get a phosphorescent glow, the color of which depends upon the material composing the vessel or obstacle. Clearly defined shadows are cast on the wall of the tube by any solid object which is interposed in the path of the stream. This stream or shaft of light may be deflected by magnets or electrified bodies brought into its neighborhood, and from the way in which these deflections occur, we are led to infer that the stream consists of a number of very small particles charged with negative electricity, moving at the rate of several thousands of miles a second. When these particles are abruptly stopped by collision with the walls of the containing vessel, they throw the surrounding ether into a state of disturbance, which manifests itself as rays of very short wave length—the famous X-rays with which everybody is now familiar, and which have such numerous applications in surgery and medical science.

The members of this stream of negatively electrified particles are identical in their properties, and they are called negative electrons. The mass of a negative electron has been found to be about 1/1700 of that of the lightest of all known atoms—the hydrogen atom. The conductor from which these negative electrons are shot off is called the negative electrode. If we perforate it streamers appear behind it, which consist of positively electrified particles, which are much larger than the members of the negative stream and also move at much slower velocities. Not only do the negative electrons set up disturbances in the ether when they are stopped by collision, but also when any change occurs in their velocities. If we merely change the direction in which an electron is moving, without altering the speed at which it moves, ether disturbances are set up, and energy is radiated away from the electron into external space. So that an electron rotating at a uniform speed in a circle is continually radiating energy, since its velocity is continually changing in direction. We shall see that this fact has an intimate bearing on the phenomena of radio-activity.

The most interesting feature about these negative electrons, and one which has transformed all our ordinary notions of matter, comes to light when we investigate the relation between the mass of an electron and its electric charge. It was shown by Sir J. J. Thomson that when a body is charged with electricity, its apparent mass is increased. This increase in mass depends not only on the magnitude of the electric charge, but also on the velocity with which the body is moving. Now the electric charge on an electron has been measured, and likewise its velocity, so that we are in a position to calculate what part of its apparent mass depends on its electric charge. When this extra mass is compared with the actual mass of an electron measured experimentally, we find that the two results are equal: in other words, the *whole* mass of an electron is due to its electric charge.

This result changes our whole concept of matter, for all matter is regarded as built up of electrons, and the mass of an electron is purely electromagnetic. The electron itself then, is not matter as we know it. We may gain some idea of the modern idea of the constitution of matter, by considering the smoke rings that some tobacco smokers are able to produce. A smoke ring is produced by setting part of the air in a particular kind of motion, a motion at once of rotation and translation, which then travels through the air as if it were a separate object. In the case of a smoke ring the little particles of smoke caught up in the air travel with it and enable us to trace its progress. We have set up a local modification of the air, which then takes on a more or less permanent existence and travels through the air as if it were some solid body. If the air were continuous and frictionless, the smoke ring would last forever, and could, in conjunction with other smoke rings, build up systems which would manifest the properties of material bodies.

Now a continuous and frictionless medium does exist, to wit, the ether. The ether permeates all space and is the universal carrier of energy, whether in the form of X-rays, light rays, heat rays, or rays of electricity. An electron, then, is regarded as some modification of part of this universal medium; it is entirely composed of ether, and is yet different from the ether, much as a smoke ring is composed of air and yet travels through it as an independent body. So that the old philosophic puzzle as to the atomic constitution or continuity of matter here receives an answer which embraces both solutions. Matter is continuous, since it is one with the ether; and matter is atomic, since it is built up of small particles which are separate from one another.

The atoms of matter are built up out of electrons much as our solar system is built up out of planets. In each case there is a central body: in the case of the solar system it is the sun and in the case of the atom it is a change of positive electricity. Circulating round this central change are a number of negative electrons, the whole system constituting an atom of matter. By a consideration of the different systems which can be built up in this way we can account for many of the properties manifested by the chemical elements. But in regarding the atom as built up in this way there is one fact which must strike us as of unusual significance. On this theory, *matter is not stable.* We have already pointed out that rotating electrons radiate energy, and here we consider an atom as built up of a system of rotating electrons. So that an atom is not a stable affair. Energy cannot be radiated indefinitely without a fundamental transformation of some kind occurring. We should expect the atom to break up eventually into some simpler form.

The phenomena of radio-activity show us that this is precisely what does occur. In an atom of radium we have a system which is in process of disintegration. The radium atom is breaking up and ceasing to exist as radium. Elements of less atomic weight, the results of its destruction, form in its place. But they also, although more stable, are not permanently stable. They, too, must break up and disappear, to give place to still simpler elements. This process cannot cease till the atom is resolved into its constituent electrons, but side by side with this disintegration of matter we have a synthesis, of which we have the clearest evidence in the stars. The older and cooler stars contain more complicated chemical elements than the hotter and younger stars, and the conclusion is irresistible that we are in the presence of a gigantic evolution of matter from its primitive source in the universal ether. Side by side with death we have birth, and the universe moves through ceaseless cycles from decay to a fresh renewing.

The Largest Insects in the World are described by O. W. Barrett in the *Philippine Agricultural Review.* The largest known winged orthopter is a species of phasmid, or walking-stick (*Palophus Titan* Sjöstedt) recently discovered in Nyassaland. Its body is 10 1/3 inches long. Borneo boasts a wingless phasmid (*Phobacticus Kirbyi* Redt.) 13 inches long. This is the largest living insect, but was surpassed by a dragon-fly-like insect (*Meganeura Monyi* Brongn.), with wing expanse of 25 inches and a body 14 inches long, which flourished in France in the Carboniferous period.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Foucault Experiment

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of February 14th, 1914, of your valued paper, you publish an interesting article, "Watching the World Revolve," of Foucault's celebrated demonstration in the Pantheon, in Paris, in 1851.

This experiment was repeated for the second time in the Spring of 1857, in the choir of the cathedral of Lausanne, by Prof. Louis Dufour, of the academy of that city.

As a young student I was witness of said experiment, which was then repeated several times before a large number of visitors.

EDOUARD SILLIG,
Former Headmaster of Silliig's School.
Bellerive, Vevey, Switzerland.

The E. J. C. Motor

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 2nd I was very pleased to see an article regarding my aviation motor, for which I wish to thank you.

I would, however, like you to correct a very important mistake which your correspondent has made in describing my motor, and which entirely destroys all the advantages that I claim for it. Your correspondent describes the motor as having a differential to regulate the speed of the two propellers. We claim just the opposite, that is to say, that we have no gears at all in the motor itself. There already exists a motor on the principle described by your correspondent, and it may mislead the interested parties the error published in your article. If my motor had a differential to regulate the speed of the propellers, it would not only not be any better than all the other aviation motors, but it would be much worse. My claim is that my motor will outlast all the existing motors of to-day, as it rotates absolutely free on its axle, which is mounted on ball bearings.

My motor is now running perfectly and flying every day at Chateaufort. We are waiting the delivery of a Caudron biplane, made under special design to hold enough gasoline for a twenty-four hour flight, with which we expect to prove that our motor is the best existing to-day. E. J. CONILL.

Paris, France.

The Coast and Geodetic Survey Tide-predicting Machine

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 30th, 1914, Mr. Fischer attempts to befog the public mind in reference to the facts contained in my note (appearing in your issue for May 2nd) by making the following statement:

"The officials of that bureau are thoroughly familiar with its development from its first inception, prior to 1890 (the year in which Dr. Harris entered the service), to its final completion."

If Mr. Fischer can furnish any reliable evidence that the general scheme which characterizes the new machine and distinguishes it from other machines existed in any sense prior to my conception of it in the early nineties, he will have rendered a service to those who may be interested in the historical development of these appliances. I have no knowledge that such plan or scheme had been conceived at some earlier date, either here or elsewhere; nor have I any reason for believing that, subsequent to the construction of the Ferrel machine in the early eighties and prior to the time when the general plan of the new machine first occurred to me, the Survey had ever considered or recommended the construction or purchase of any tide-predicting machine other than some machine of the Thomson type.

Mr. Fischer's *Engineering News* article, and to which he refers, was apparently written largely in the attempt to minimize or ignore my claim as the originator of the machine. Moreover, the article contains statements which cannot be successfully defended.

Washington, D. C. R. A. HARRIS.

The 72-inch Reflecting Telescope now under construction for the Canadian government, a description of which was recently published in these columns, is to be located on Little Saanich Mountain, near Victoria, B. C. This site was chosen after prolonged investigation of atmospheric conditions in different parts of the Dominion, and despite the fact that its selection entails much additional expense for the purchase of land, the construction of a road, and other preliminaries, as compared with other sites that were under consideration.

Manhattan Island: a Body of Land Surrounded by Sewage

Sanitation of River Bathing

By Donald B. Armstrong, M.D., Director Department of Social Welfare, New York Association for Improving the Condition of the Poor

A typical floating bath. Coarse screens keep out the solid portion of the sewage, but the water is none the less contaminated, and, therefore, a menace to health.

THE majority of people have reached the point where they prefer their milk undiluted with typhoid-contaminated human excrement. This is, of course, partly a matter of decency, but largely a matter of health. Somewhat in contrast to this, it is found that most cities make large expenditures for street sprinkling, so that the food to be eaten may not be covered with a dusting of granulated horse manure. This is placed in contrast to the first proposition because, while there is an appreciable health factor, the chief justification of our effort in this field is based on decency. Most of our health or pseudo-health activities are founded on decency or health, or both. Rarely a problem is met where the two motive forces are not almost equally intermingled. Such would seem to be the case in the question of bathing in semi-sewage. It has been said that "Manhattan Island is a body of land surrounded by sewage." This is scarcely an exaggeration, for the waters adjacent to Manhattan, affected as they are by tidal currents, preventing a continuous and free flowage, receive about 490,000,000 gallons of sewage per day. This excrementitious material is inevitably infected and must remain, for a time at least, infectious. At certain times there is not a slip in the North or East River in which it is impossible to see human excrement. It was found necessary in the municipal floating baths, constructed with slats separated so as to permit the free entrance and exit of river water into the bathing tank, to nail additional slats over the openings, narrowing the spaces, so that the larger and, consequently, more objectionable particles of sewage did not enter. At the open beaches in the North River it is necessary to screen the river water as it flows down from the adjacent sewer by the bathing establishment, so as to remove the unesthetic sludge. Screening, while admittedly necessary in this situation, is not considered a final method of treatment in sewage disposal, and obviously would be particularly objectionable as such if we are using the sewage for drinking purposes, and that is practically the situation when it is used for bathing. It is impossible to maintain a bath on the shores of Manhattan Island not adjacent to a sewer exit, for there are 149 sewers emptying into the rivers from that borough alone. Hundreds of thousands of people use this medium for cleansing and recreation purposes every Summer. It is equally dangerous and indecent. Its sanitation or elimination is essential for establishing public decency and for insuring public health in New York city.

At the present time there are three main types of bathing in New York harbor:

1. Unregulated Bathing.

This promiscuous and surreptitious bathing is from the piers and bulkheads at the foot of many of the streets. This is forbidden, though the enforcement of the regulation is practically impossible without a more thorough policing of the waterfront.

2. Beach Bathing.

There are several open beaches in New York Harbor, north of the Narrows and south of Spuyten Duyvil and the Bronx Kills, notably those adjacent to Washington Heights on the upper North River. Nothing is done, and of course nothing can be done at these places short of a radical change in our method of sewage disposal, to sanitate the water used in these baths.

3. The Floating Baths.

These are both public and private, and are situated in the North River and the East River and at the Battery, in the Boroughs of Manhattan and Kings. The baths of this type maintained by the city alone were used by 1,818,721 bathers in the year 1911. Yearly in New York there are about 550 deaths from typhoid fever, which means an incidence from this disease of about 5,000 cases. How much of this infection is a result of the short-circuit of contaminated excrement from individual to individual through river bathing it is impossible to say. It would seem safe and reasonable to assume, however, that the factor was not a negligible one.

What are we to do with these various forms of bathing? All authorities are agreed that the water should not be used unless in some way treated and rendered both safe and decent. Those who have reached this conclusion are agreed, also, that unregulated promiscuous bathing, as well as unprotected beach bathing, must be discontinued, for at the present time it is impossible to treat the water properly in these instances. What can be done with the floating baths? The results of bacteriological studies carried on by the Bureau of Public Health and Hygiene of the New York Association for Improving the Condition of the Poor indicate that radical treatment is necessary.

The counts practically represented the condition of the river water as well as of the water in the baths. The inconsistency of permitting bathing in this highly-polluted water without any attempt at purification and at the same time insisting on filtration and disinfection of Croton water for indoor pools is obvious. At the present time Croton water rarely contains over 100 bacteria per cubic centimeter, and with great consistency Colon bacilli are *not* found in 10 cubic centimeters. This water is filtered and disinfected when it is used in indoor pools. In contrast to this, the floating baths have encouraged bathing in semi-sewage where the bacteria are frequently as high as 3,000,000 per cubic centimeter, and where Colon bacilli, undoubtedly of human fecal origin in this location, are found frequently in quantities as small as 1/1000 cubic centimeter.

With the floating bath it is possible to do one of three things, and these possible solutions will be discussed under the following headings:

1. Discontinuance.

This would seem to be the most logical and economic method. Floating baths as originally constructed cost the city $12,000 or $15,000 apiece. They were simply floating basins, having on them dressing-rooms and toilet facilities. They do, undoubtedly, take advantage of the tendency of the boy to go in swimming in the Summer time. At the same time, when, as under present conditions, he is compelled to satisfy that desire by swimming in sewage, one concludes that a redirection of the same tendency is worth the expenditure of a great deal of energy and money. The floating baths are open on an average of about three months a year, while an indoor bath may be kept open, and ordinarily is, the year round. The increased effective-

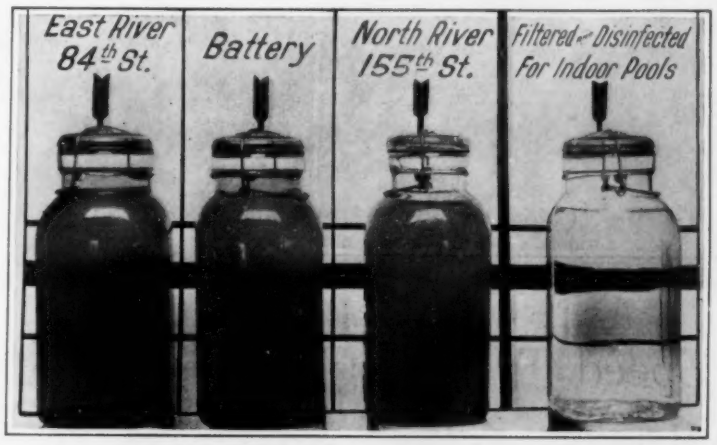
ness of the indoor bath, because of the fact that it is open the year round, is a factor worthy of serious consideration. It would require $30,000 as the initial cost of providing a single model floating bath with filtration and disinfection, the operating expenses of which would undoubtedly be greater than those from which the above figures were taken, and the efficient and safe handling of which would be exceedingly doubtful under the best of circumstances. It may be said that for three times that amount a reasonably large indoor bath, equipped with showers and a pool, could be constructed. The West Sixtieth Street bath, containing 69 showers, 1 tub, and 1 pool, cost $126,550 in 1906. If the plan were, as has been previously advocated, to have smaller baths, with fewer units, at more frequent intervals, and if it were planned to have, eventually, these small baths at reasonably frequent intervals in the congested population centers near the water's edge, it might be reasonably supposed that the ideal bath for these purposes would be smaller than the West Sixtieth Street plant. It is probable that an equipment of 40 showers and a smaller pool would cost approximately $90,000. If the floating baths were entirely discontinued, and were replaced by small indoor baths at frequent intervals, there would undoubtedly have to be, for a time at least, some policing of the waterfront, to prevent the boys from going in bathing off the wharves. Positive measures of public bath advertising would help to accomplish this.

2. Reconstruction for Use of River Water.

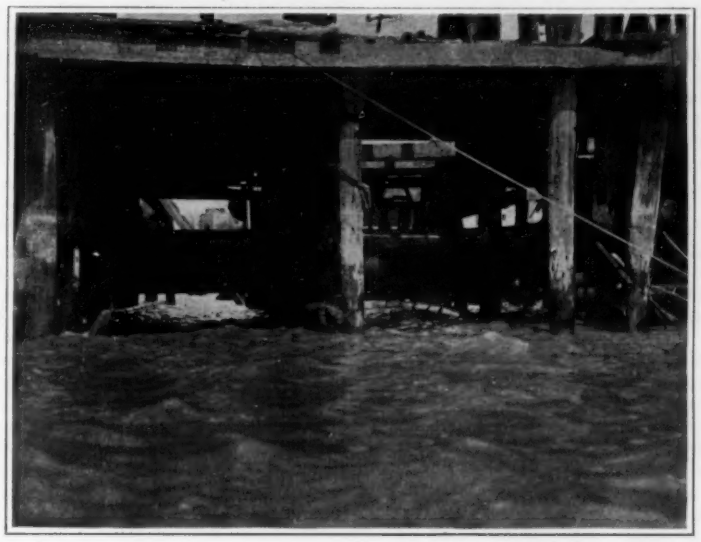
In some experiments carried on last Summer in co-operation with the Department of Public Works, the Department of Social Welfare of the Association for Improving the Condition of the Poor had a tentative plan drawn up for an equipment that would meet this need to be attached to one of the present municipal floats. This was so devised as to permit the use of either fresh water from a street main or salt water from the river, disinfected with hypochlorite of lime and filtered. The present municipal floats were constructed in 1889 and have seen a good deal of wear and tear, so it is doubtful if they would stand much more service when subjected to remodeling with additional equipment. This is particularly true in view of the fact that additional equipment would have to include pumping apparatus. Here also enters in another objectionable item of expense, especially when it is to be of use for only three months of the year. It would seem that permanent all-year-round indoor pools were decidedly more advantageous and promising than river bathing under these conditions. It may be logical and desirable to turn to the river for our baths when we have found a way of discontinuing contamination of the river as a whole. The success of purifying the water piecemeal, so to speak, is extremely doubtful.

3. Reconstruction for Use of Fresh Water.

In co-operation with the municipal authorities, a tank of this kind was actually completed and put in use in September of last year. Croton water was used from a street main and was run into a float at the foot of East Fifth Street, being distributed by a number of inlet pipes placed at the bottom of the pool. The water was disinfected with hypochlorite and was run into the pool without filtration or refiltration in sufficiently large quantities to change the water in the pool at least once every day. With this plan there was no pumping expense, though there was a large waste of Croton water. The experiment was not a great success for several reasons, the chief one of which was the non-water-tight construction. Safety and decency can undoubtedly be secured by this method with a greater outlay, though the plant is useful for only a small part of the year, and it would seem that the money which must be spent on the additional equipment and reconstruction might be more effectively employed in increasing the capacity and the use of the all-year-round baths.



Four samples of Hudson River water from widely separated points.



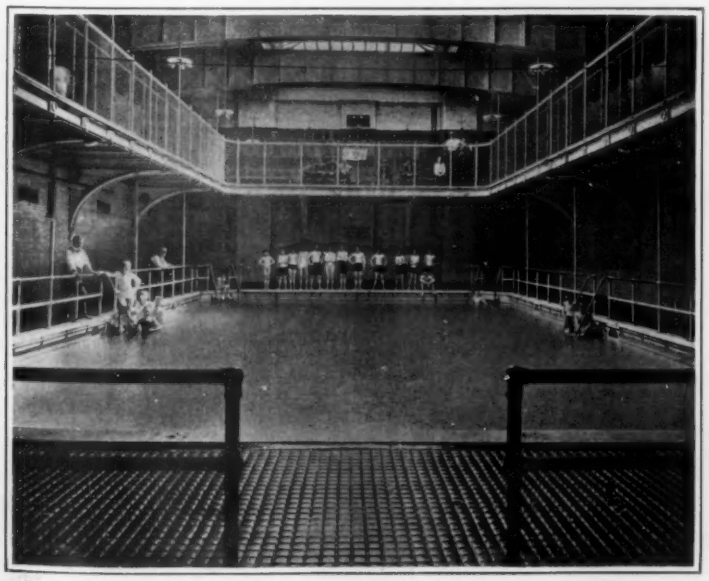
Sewer discharging into Hudson River.

Recently the Board of Health of the city of New York approved a set of regulations regarding bathing in pools in or adjacent to New York city. These rules require water-tight construction, sanitary toilet facilities, shower facilities, etc. In view of the additional equipment which these requirements imply, it would seem that the first method discussed, that is, discontinuance, were the one to be advocated. With this should go, of course, positive constructive measures regarding the indoor pools. It is probable that very few private-bath owners can afford to make the changes necessary. Is it a rational municipal expenditure?

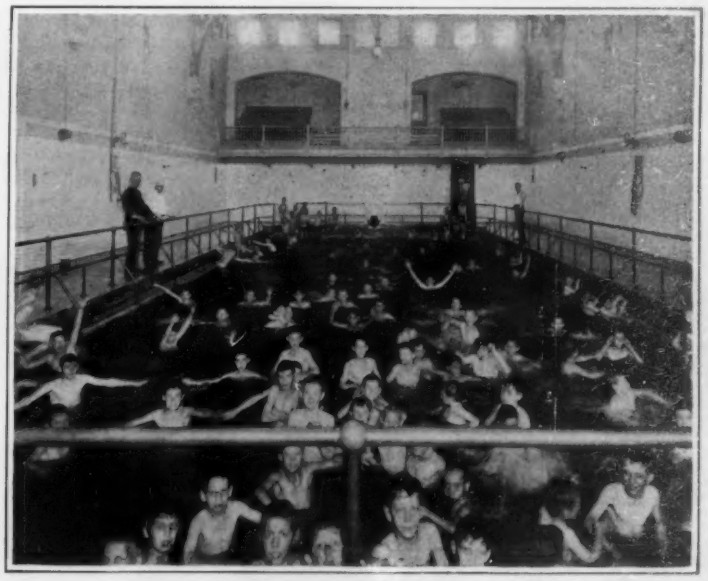
The chief justification for this municipal activity, in any event, is its educational value. At the present time the city has an excellent nucleus of cleanliness and health-promoting indoor pools. Those already in use are to be found at Rutgers Place, East Twenty-third Street, and West Sixtieth Street. A new one is to be opened immediately at the Rivington Street bath, while three more pools, two at East Fifty-fourth Street and one at West Twenty-eighth Street, are under construction. Still another is planned at Carmine Street, and it is hoped that the municipality will see the necessity for the construction of a pool on the upper East Side, possibly in connection with the bath on East 109th Street. Besides these plunges the city has, at the present time, distributed in twelve public baths, 1,297 shower units and 80 tub units, the use of which, together with the pools, is entirely free. These indoor baths encourage cleanliness all the year round, while the river baths practically afford a series of swims during the Summer time. The floating bath is not nearly so apt to form a bath habit, for it must be discontinued in the Fall. The returns, in cleanliness and health, from an investment in indoor-all-year-round baths promises to be many times what might be the expected returns from the floating baths.

The Gordon Bennett Race

THE French Aero Club had some difficulty in deciding where this year's Gordon Bennett aeroplane event was to take place. On one hand, the municipality of Vichy proposed to organize the affair and to lay out the grounds, and on the other hand, M. Blériot offered the Buc grounds for the event. Opinion lay in favor of holding the event at Buc, for this year's rules require a circuit of 3 miles' length and 300 feet width, upon which an automobile can run at slow speed. Such a track costs much to lay out, but it can be done more easily on the Buc grounds, for these are already in good condition. Pilots, of course, prefer the track which lies near Paris and is among the aviation centers, and as regards the attendance of the public, the latter place is a much better one. Accordingly, after some discussion, it was decided to hold the cup event at the Buc grounds, and it will take place in September. It seems undecided as yet whether or not the United States will participate.

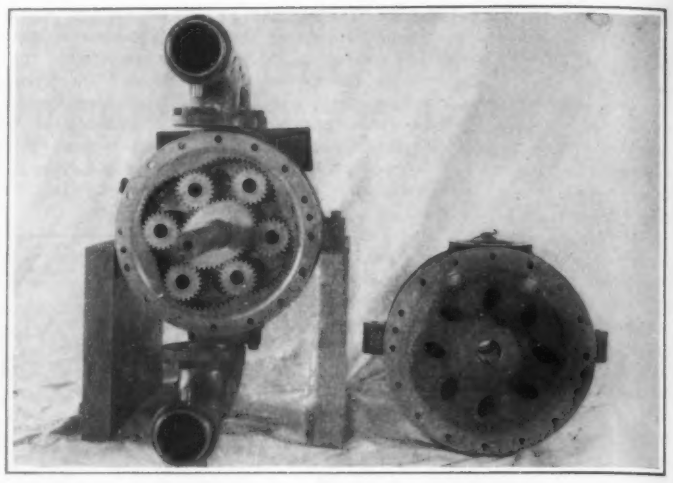


The pool of the municipal bath in West Sixtieth Street, New York.



An active hour at the East Twenty-third Street pool in New York.

The planetary gear pump throwing a powerful stream.



The odd gearing of the fire pump.

Variable Speed Transmission and Rotary Pump

A Hydraulic Motor Using Planetary Gears for Piston

FOR many years, particularly since the advent of the automobile, many efforts have been made to devise a simple variable speed transmission gearing. Such gearing is needed in an automobile to transmit power to the differential without the use of change gears; in battleships to elevate the guns and train the turrets; in machine tools to provide different speeds without shifting belts and gears. As yet no strictly mechanical transmission gearing of this type has been commercially developed, but there are several hydraulic systems in use.

Herewith we illustrate a new transmission gear of the hydraulic type, which, however, differs materially from previous gears and is decidedly original and ingenious. It is the invention of Mr. Herman Dock.

It works on the motor and a pump principle, the pump supplying fluid to the motor in volume controllable at the will of the operator, thus controlling the speed of the motor. Motor and pump are similar in construction, and will be understood by referring to the sectional view, Fig. 1. Fixed to the casing of the motor is an internal gear *A*, which is of quadrilateral form. Mounted on a shaft at the center of the casing is an elliptical gear *B*, while between the elliptical gear and the internal gear are six planetary gears, 1, 2, 3, etc. The design of the internal gear is such that when the elliptical gear is revolved, the planetary gears will mesh with both the internal and the elliptical gears at all points. The planetary gears will, of course, travel in the direction of rotation of the elliptical gear, owing to their contact with the internal gear. The planetary gears may be considered the pistons of the motor, while the spaces between them are the cylinders. It will be noted that the space between planets 1 and 2 is much greater than that between planets 2 and 3. As the planets progress in the direction of the arrows the volume of the cylinder space between pistons 1 and 2 diminishes, while that between pistons 2 and 3 will grow larger. Hence, if this be considered a pump with inlet and exhaust ports, the first cylinder will be discharging through port *C*, while the second cylinder will be sucking through port *D*. Conversely, if the apparatus be used as a motor, fluid admitted through port *D* will cause the pistons to progress so as to increase the cylinder space between pistons 2 and 3 while at the same time the fluid in the cylinders between pistons 1 and 2 will be discharging through port *C*. It is interesting to note that while the elliptical gear advances 135 degrees, the cylinders advance only 45 degrees, and while there are only six cylinder spaces, the machine operates as if it had eight cylinders, and there are eight discharge and inlet ports.

Fig. 2 shows how the mechanism is employed as a variable speed transmission. It consists of two parts, namely, a motor and a pump. The pump consists of two units. The internal gear of the motor is indicated at A^1, and the elliptical gear at B^1, while the internal gears of the pump units are shown at A^2 and A^3, and the elliptical gears at B^2 and B^3, respectively. One of the pump units is adapted to deliver fluid through the other pump unit. The internal gears A^2 and A^3 are adjustable one with respect to the other under control of

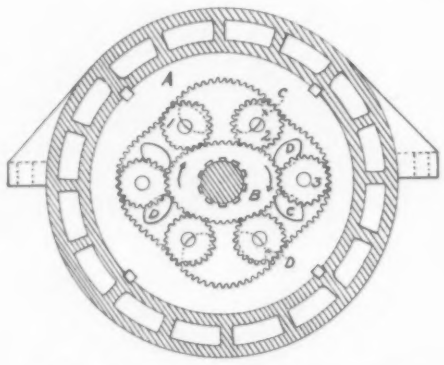


Fig. 1.—How the cylinder spaces progress.

the lever *E*, which operates a bevel pinion *F* meshing with beveled teeth cut on the adjacent faces of the gears.

Figs. 3 and 4 show the results of adjusting one gear with respect to the other. In the position shown in Fig. 3, one pump unit is indicated by full lines and the other by dotted lines, it will be seen that a cylinder of one pump member faces a discharging cylinder of the other, so that one takes in all the oil that the other discharges, and no fluid is delivered to the motor. When, however, the gears are moved to the position indicated in Fig. 4, the sucking cylinders of the two pump units pull together, and the discharging cylinders discharge together, consequently a maximum amount of fluid is delivered by the two pump units to the motor, and the latter is now driven at full speed. Any speed between maximum and zero may be obtained by relatively moving the two gears A^2 and A^3 between the extreme positions shown in Figs. 3 and 4.

It will be noted that this is a true rotary in absolute mechanical as well as hydraulic balance, so that there is no pressure on any part that is not absolutely met with the exact pressure on the opposite side. In fact, if gears could be cut perfectly and would not wear, there would be no necessity for a bearing. Up to the present writing, no engineer in this country or Europe has been able to lay out the pitch line of the internal perfectly. It was found by the "cut and try" method and then master cutters were made.

The accompanying photographs show a fire pump constructed on this planetary gear principle. Recently, on an endurance test of 100 hours, this pump, measuring only 9½ inches in diameter by 2½ inches in length, made 4,800,000 revolutions and delivered 1,100,000 gallons of water.

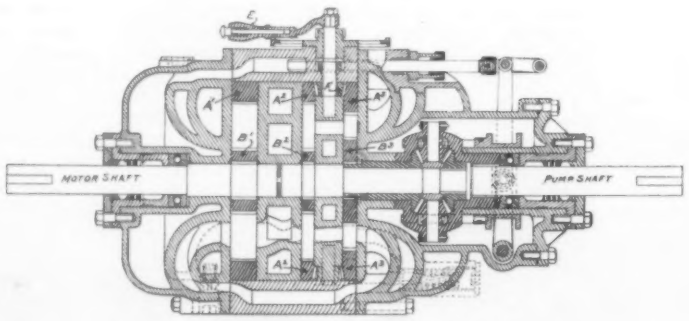


Fig. 2.—Longitudinal section of the variable speed gear.

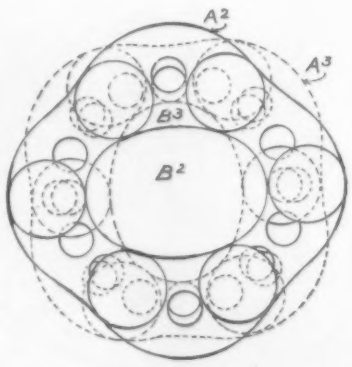


Fig. 3.—Pump units opposed.

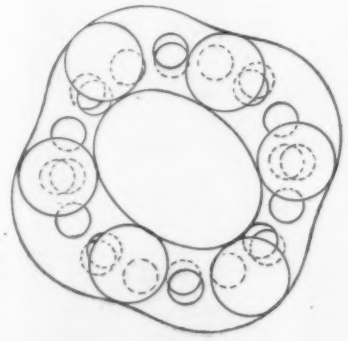


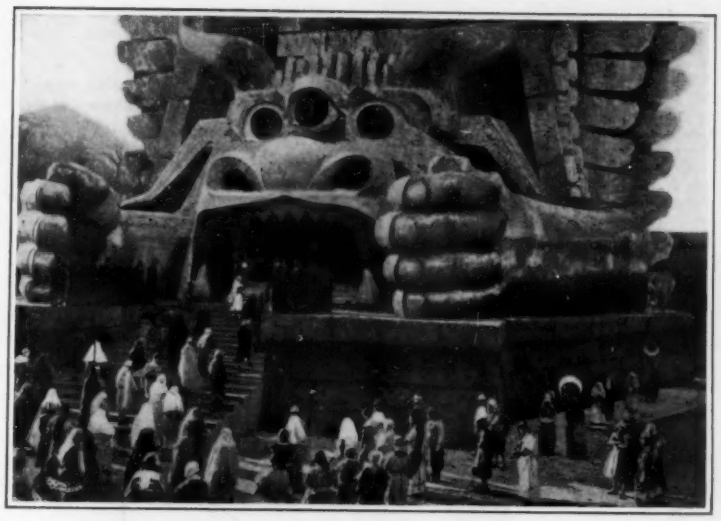
Fig. 4.—Units working together.

Counterfeit Weather Forecasts

ALTHOUGH the almanac weather prophet still plies his trade to-day, as he did hundreds of years ago when Justus Stöffler threw all Europe into a panic by announcing that certain planetary conjunctions would bring about a second deluge, it appears that there are legal snags upon which the modern prognosticator is in danger of running, if he happen to utter his predictions within the jurisdiction of the United States. Proceedings were recently brought in the United States court at Detroit against the publishers of a "Family Almanac" under a section of the Penal Code, which reads as follows: "Whoever shall knowingly issue or publish any counterfeit forecast or warning of weather conditions, falsely representing such forecast or warning to have been issued or published by the Weather Bureau, United States Signal Service, or other branch of the Government service, shall be fined not more than five hundred dollars, or imprisoned not more than ninety days, or both." On the title page of the publication in question appears the following statement: "Including a map of the United States and Uncle Sam's Weather Predictions." Needless to say, the predictions, which are made up for a year in advance, are not "Uncle Sam's." The publishers were found guilty and fined $100 for each of the three years during which the forecasts had been issued.

Elaborate Moving-picture Scenery

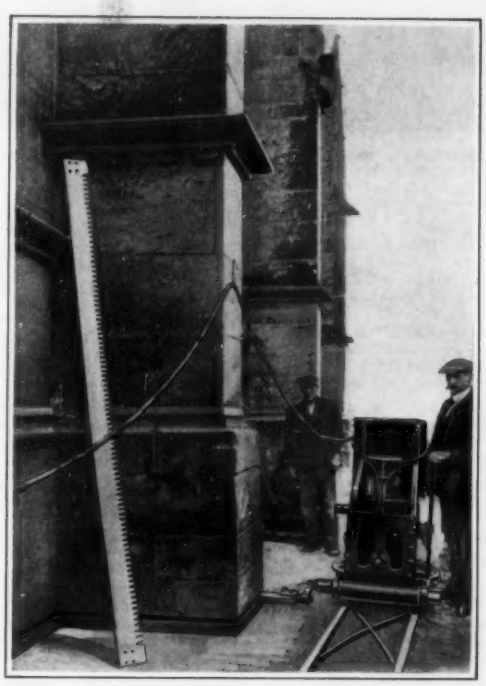
EXAGGERATION of the cost of moving-picture films is the rule rather than the exception, and so when we hear that a recent film has cost a quarter of a million dollars to produce, we are sure that the actual amount has been greatly overstated. Nevertheless, D'Annunzio's photo-play "Cabiria," it may readily be seen, involved an enormous expenditure. It rivals such plays as "Ben Hur" and "Quo Vadis," but differs from them chiefly in having been written particularly for the kinematograph. The author personally managed the staging of the play and, in order to have it as real as possible, the actors were engaged long before the final performance, in order that those who were to represent athletes could develop their muscles by gymnastic exercises, and those who were to represent bearded men could raise real beards, and thus avoid the usual wig and make-up. The story of the play belongs to the time of Hannibal and the scenes vividly portray the horrible religious rites of human sacrifice practised at Carthage, in the Temple of Moloch. Cabiria is a Roman girl stolen by Phœnician pirates and sold to the priest of Moloch, who is about to offer her as a sacrifice to the "God with the White-Hot Heart" when she is rescued. To stage the play, a most elaborate temple was built of plaster. The accompanying illustration represents the great gate of the Temple of Moloch. There are interior views of marble halls richly decorated and ornamented with representations of the sculpture of that time. In addition to the scenes at Carthage, there are views of Hannibal leading his army over the Alps, a Roman battle at Cirta with catapults, derricks, and all the machinery of ancient war. The pictures were taken in Italy, Sicily, Switzerland, Africa, and Spain.



Gate of the Temple of Moloch, constructed for a photo play.

Machine for Sawing Stone Walls

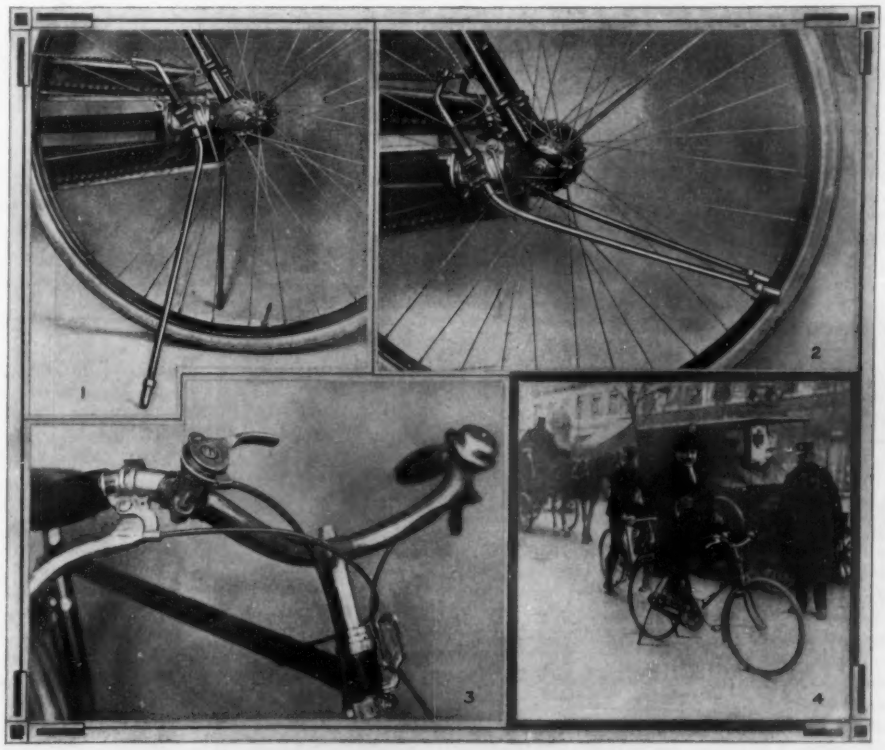
THE modern builder thoroughly appreciates the importance of waterproofing foundation walls to prevent dampness from creeping into them and injuring them. Accordingly, it is the custom to protect the foundation walls with a good coating of asphalt or the like. However, there are many buildings, particularly in the older countries, in which no such provision against the entrance of dampness and frost was made. In order to preserve these buildings, a method of insulating them against dampness has been devised by a German engineer. It consists in sawing a slot in the foundation wall just above the ground line and introducing in the slot asphalt-coated lead plates. A special machine has been designed to saw the masonry, producing a kerf about one inch wide. As the work is done progressively, the plates being introduced as the sawing proceeds, the stability of the building is not endangered. However, to prevent any possible accident, conical iron cramps are introduced in the saw kerf. After the introduction of the insulating plates the slots are closed with temporary wooden forms, and then they are grouted with liquid cement, which completely fills them and any gaps still left open. The cement adds to the insulation, and the wall is thus thoroughly protected against creeping of moisture from the ground upward. To dry out the walls over the insulating plates, a special stove is provided.



Sawing foundation walls to introduce waterproofing plates.

Bicycle Fitted With Side Props

THE convenience in having a device for making a bicycle stand still when it is stopped on the road will be at once appreciated, for it will come into use in numerous cases when the rider wishes to stop without dismounting from his machine. Our photographs show a bicycle in this position, it being held by a forked support at the rear, and the various details of the device are also noticed. The supporting device is of a most simple kind, and is at once brought into use by pressing on a lever. On the lower tube of the bicycle frame and next the rear wheel hub is clamped a bracket. This serves to hold a light steel rod on either side of the machine, which forms the support. The rod is journaled in the bracket, but, being a bent shaft, its lower leg takes the two positions shown in Figs. 1 and 2, when it is turned in its bearing. In the first position the leg projects to one side as a prop, while in the second position it is folded up against the side of the wheel. All the movement is controlled in an easy manner, by the use of a lever. Various means can be adopted for placing this lever, but the best one is shown in Fig. 3. On the handle rod is mounted the usual brake, seen on the left, and next to it is a lever of quite similar kind, but somewhat differently mounted, so that by pressing the lever we pull on a wire in quite the same way as for the brake. This wire works in the customary flexible tube, and it goes down along the frame to the bent upper end of the pivoted rod or leg which we mentioned above. A double wire allows of working both legs at the same time. A spring upon the collar or support keeps the legs held up in the inactive position, and when the lever throws them upon the ground, a suitable clamp or lock device keeps them there, so that the hand pressure need not be further applied. It will be seen that the device could hardly be simpler or easier to operate. When on the road, it will now be possible to stop for a moment in order to enjoy a view, or even to take photographs, and for this latter use it will be most useful in allowing time-exposures to be made, the bicycle serving as a tripod. In cities and when traveling upon crowded streets where the rider becomes blocked by vehicles, he is able to stand still until free to proceed, without being obliged to dismount, as so frequently happens.



Bicycle props that may be brought into position by pressing a lever.

News from the "Karluk"

THE mystery which has enshrouded the fate of Vilhjálmur Stefánsson's ship "Karluk" since she drifted away from the Alaskan coast, September 22d, 1913, carrying with her about half the scientific staff of the Canadian Arctic Expedition, is now happily at an end. A dispatch from St. Michael's, Alaska, announces the arrival at that place of the "Karluk's" sailing-master, Capt. Bartlett, with the news that the vessel was crushed by the ice and sank about sixty miles off Herald Island (northwest of Bering Strait) on January 11th. The ship's company escaped over the ice to Wrangel Island, from which point Bartlett sledged to the Siberian coast, where he fell in with the whaler "Herman," which carried him to St. Michael's. As soon as navigation opens, the Canadian government will undoubtedly send a vessel to rescue the party marooned on Wrangel Island. Much interest attaches to the course over which the "Karluk" drifted, as bearing upon the plans of Amundsen and others to approach the pole by drifting from a point north of Bering Strait. The drift of the "Karluk" ended almost exactly where that of De Long's ship "Jeanette" began, in 1879; while the point at which the "Jeanette" sank was not very far from where the drift of Nansen's "Fram" began, in 1893. The combined routes of these three vessels thus give a general idea of the drift of the Arctic currents more than half way around the north polar basin. They are at once unfavorable to the plan of utilizing ocean currents as a means of reaching the pole, and favorable to the idea that extensive lands exist in the unexplored region of the Arctic Ocean. News is now eagerly awaited of Stefánsson's proposed sledge journey northward from the Mackenzie delta and of MacMillan's northwest from Axel Heiberg Land; either of which may have resulted in the attainment of the lands in question.

Yellow Poplar, or tulip tree, the largest broadleaf tree in America, has been known to reach nearly two hundred feet in height and ten feet in diameter.

New Apparatus for Writing at a Distance

A VERY ingenious apparatus has just been introduced from Germany, which is designed to transmit writing, drawing, and the like over a telephone or telegraph line to an instrument which makes a perfect reproduction of the original. Telautographs have long been in use, but this apparatus differs from others in many important particulars. The writing at the receiving end is done by a pencil of light which travels over a sensitized sheet of paper. The message is thus photographically reproduced, the sensitized paper being developed automatically, in the machine, in a few seconds' time.

The scheme of the device is shown diagrammatically in Fig. 1. At the left is the transmitting station; the receiving station at the right. The position of a point is determined by noting the length of its abscissa and of its ordinate, in relation to two axes, or, to borrow a geographical simile, by noting its latitude and longitude. It is therefore merely necessary to transmit the latitude and longitude to the receiving station in order to locate the same point on a sheet of paper at that place. Accordingly, the pencil P is provided with means for controlling two variable resistances R^1 and R^2, respectively. These, in turn, control delicate galvanometers G^1 and G^2, respectively, at the receiving station, each fitted with a tiny mirror. As more or less resistance is thrown into the circuit at R^1, the mirror B of galvanometer G^1 is more or less deflected, and a beam of light from the lamp A, playing upon this mirror, has its reflection correspondingly deflected. The reflected beam is cast upon the mirror C, which is mounted to turn on an axis at right angles to that of mirror B. Mirror C is deflected by variations in the resistance introduced at R^2, further modifying the direction of the beam reflected therefrom. In other words, one of the mirrors determines the latitude of the point of light that falls upon the sensitized paper D, while the other controls its longitude. Accordingly, as the pencil is moved over the paper at the transmitting station, the pencil of light at the receiving station must reproduce the same line, point for point, on the sensitized paper.

In the photograph of the receiving apparatus, the place where the lamp is introduced is indicated by the letter A. The light from the lamp passes through a series of lenses and reflectors to the small mirror B, then to the mirror C, finally falling upon the sensitized paper at D. The developing tank is shown at E. After the message has been written, the machine automatically reels off the exposed paper, cuts it off, passes it through the developer, and issues it finally through the slot F, completely developed, fixed and dried, all in fifteen seconds.

Detail views of the transmitting pencil and the variable resistance coils it controls are shown in Fig. 2, the upper view representing a side elevation, and the lower view a plan with the pencil and pencil arm broken away and the top of the casing removed. The pencil is indicated at P, while at P^1 is an automatic contact which closes when the pencil is swung up to the writing position. The system is active only when the pencil is held in writing position and the lamp A glows only when the pencil is pressed down in contact with the paper. So the act of moving the pencil across the paper to dot an i or cross a t is not accompanied by a corresponding movement of the beam of light at the receiving station. As soon as the writer is through with his message, he lays down the pencil, whereupon contact P^1 is broken and the transmitting system becomes inactive, but the developing mechanism at the receiving station begins to operate. Not until the message has been developed can another message be written. If the operator should write a second message during the period of developing, no message would be transmitted. As soon as the receiving apparatus is ready for the second message, the fact is signaled by a disk on the transmitting apparatus, which shows white. Then the writer, on picking up his pencil and beginning to write, will hear a slight buzzing noise, indicating that the receiving apparatus is reproducing his message properly. In other words, "he hears himself writing at the receiving station."

Receiving instrument with casing opened to show the mirrors B and C, which direct the spot of light upon the sensitized paper D.

Transmitting a message with the photographic telautograph.

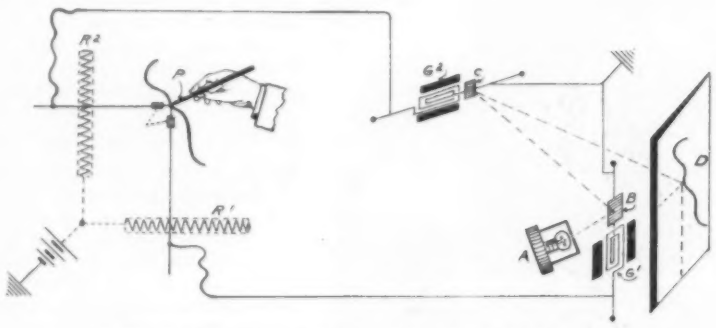


Fig. 1.—Diagram of the main circuits of the improved telautograph.

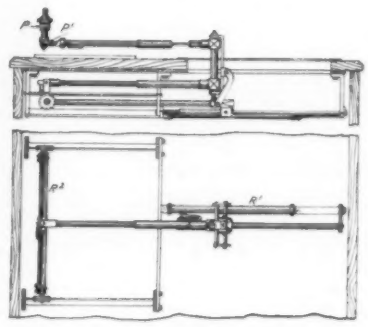


Fig. 2.—The transmitting pencil and resistance coils.

Referring again to Fig. 2, the essential details of the transmitting station are clearly shown. The pencil proper is supported upon an arm which passes through a slot in the top of the casing and is pivoted upon a carriage. As the carriage slides back and forth in the slot, contact is made with the variable resistance coil R^1. As the arm swings upon its pivot, contact is made along the resistance coil R^2, which, it will be observed, is mounted upon the wheels so that it can travel toward or from the pivot, to adjust itself to the variable reach of the arm. One of the principal advantages of this apparatus is the fact that a message may be corrected; a word or a line may be inserted at any point after the message has been written, and not until the operator is satisfied that the writing is just as it should be, need he drop his pencil and have the photographic reproduction developed at the receiving end. This permits of transmitting drawings as well as ordinary writing. Instead of moving a pencil at the receiving end in frictional contact with the paper, there is the practically negligible inertia of two light mirrors. This permits of operating the device rapidly and accurately. The writing may be as small as desired, while the message received, being photographic, makes a fixed record that cannot be altered. The roll of photographic paper is sufficient to reproduce a hundred messages on sheets the size of a postal card. When the roll is nearly exhausted, warning is given by special marks on the last few sheets of paper, which will serve to notify an attendant that a new roll and a new stock of developer must be placed in the machine. Very little current is required to transmit a message over a mile or more.

Measuring Human Comfort

PROF. LEONARD HILL, F.R.S., and Mr. O. W. Griffiths have devised what they call a "caleometer," an instrument designed to measure the degree of comfort in a room, or a public hall, or a factory, in so far as that depends on the rate of cooling of the human body. The "coil," which is made of a wire having a temperature coefficient, forms one arm of a Wheatstone's bridge, the other arms of which are made of an alloy whose electrical resistance does not vary with the temperature. The bridge is balanced when the temperature of the "coil" is approximately that of the human body, the current being supplied from accumulators or from the main supply. Any tendency to variation of this temperature is checked by an automatic rheostat, worked by a relay, so as to diminish the current when the temperature rises, and *vice versa*. The indicator in the box shows at any instant the number of calories per minute supplied to the coil to keep its temperature constant. The coil can be placed at any distance from the indicator, to which any number of coils can be switched in succession, if necessary. Comfortable conditions are indicated by gentle oscillations of the pointer—about a mean value of 30 calories per minute. A low steady reading denotes monotony and oppressiveness; violent oscillations about a high mean value are evidence of excessive cooling by an unpleasant draught.

New Cathodic Glow Lamp

By Henri Marchand

IT has long been known that when a Geissler tube is subjected to an electric discharge, the negative electrode becomes hot, to a degree more or less marked, according to the intensity of the discharge and the current producing it. Based on this phenomenon, Dr. Greinacker, Zurich, has developed the new cathodic glow lamp here illustrated.

The lamp consists of a spherical glass bulb containing two electrodes (*SS*, Fig. 1), each consisting of a Nernst heater contained in a quartz tube, and sealed in by means of magnesia and pipe clay. Connecting wires of platinum are indicated at *Pt*, *Pt*. Air is drawn from the bulb, until the pressure is reduced to some millimeters of mercury.

When the lamp is submitted to an alternating current of 1,000 volts, discharges take place, which soon heat the electrodes to a white-heat. With a current of, say, 0.1 ampère, the light furnished approximately equals that of a 50-candle-power lamp.

The voltage necessary for lighting the bulb will perhaps be diminished by using a suitable gas in the bulb, modifying conveniently the nature and pressure of the gas, etc. The appearance of the lamp when beginning to glow is shown in Fig. 2. The electrodes soon become incandescent.

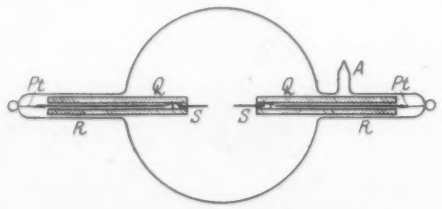


Fig. 1.—Construction of the cathodic lamp.

Fig. 2.—The cathodic lamp beginning to glow.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Heating and Lighting.

EXTENSIBLE ELECTRIC LIGHT FIXTURE.—S. GARRECHT, Idaho City, Idaho. The invention relates to suspended electric light fixtures employing a flexible suspending means, having a spring acted winding drum or barrel and a lazy-tongs composed of hollow members to receive the conductor wires. Novel means are provided for mounting and securing the winding drum, for guiding the extension elements and for preventing the lazy-tongs from swaying.

HEAT-INSULATED RECEPTACLE.—L. W. WHITE, Alzada, Montana. The receptacle combines the features of a sterilizing vessel and a fireless cooker. As a kettle it is provided with a lid adapted to be sealed for the purpose of retaining the vapors and flavors up to a certain desired high pressure. To form it into a fireless cooker, a special insulated bottom is provided which may readily be attached.

OIL BURNER.—G. A. ULRICH, City of Mexico, Mexico. This oil burner is provided with a chamber for superheating steam before it comes in contact with the oil, to raise the temperature of the oil as it leaves the burner. The superheating is disposed over the mixing chamber and the steam from the superheating chamber is discharged below the outlet for the combustible mixture.

Household Utilities.

STOVE-KEY PLATE RATCHET-SUPPORT. J. E. LEONARD, 371 So. 19th St., Cedar Rapids, Iowa. The invention is an improvement in stove top plate ratchet supports and is designed to overcome objections to the ordinary support of this type, means being provided for supporting the plate with a variety of adjustments automatically operating by the movement of the plate. When the plate has been moved to an extreme position, it automatically disengages the ratchet mechanism and returns to normal position.

TABLE.—A. and L. RENZETTI, care of A. Alvino and Figle, 224 Lafayette St., New York. The invention relates to tables having adjustable tops whereby extra leaves may be added or removed when desired for increasing or decreasing the top of the table. The construction is such that the center of the top will always remain over the center of the pedestal of the table, thereby providing an even balance for the pedestal without the necessity of dividing the pedestal into parts.

PORTABLE AND FOLDABLE BATHTUB.—MRS. N. F. BONIFACE, 124 W. 44th St., New York, and SYMONA N. BONIFACE, New York. This bathtub is designed for bathing babies, and is arranged to insure the utmost comfort of the baby while being bathed, to permit the attendant to fill and empty the tub conveniently, and to allow of turning the tub around, to facilitate the washing of the baby. The tub may readily be folded into a small bundle for storage or shipping purposes.

Of General Interest.

BALE BAND TIE.—I. M. THOMPSON, De Ridder, Louisiana. The invention provides a tie that may be applied quickly and removed readily. It is so formed that the band will hold the tie in place with only the slightest assistance from a spur or projection extending from the tie into the bale to which the tie is connected.

HANDLE ATTACHMENT.—W. H. JAYNE, 414 East 23rd St., New York, N. Y. Mr. Jayne's invention relates to handles removably associated with a brush or similar article, the top of which article is also removable. The object is to provide an additional handle attachment for brushes which may be used for different articles, provided with means for engaging a handle.

ANCHOR FOR SUBMARINES.—G. E. ELIA, Hotel de Crillon, Place de la Concorde, Paris, France. The invention provides a means for automatically locking the mooring winch when the anchor for a submarine mine reaches the desired position at the bottom of the sea, in order to render the length of the mooring cable independent of eventual displacement of the anchor under the influence of currents or other causes.

BLANK BOOK.—S. R. CLARK, care of Spalding City Bank, Spalding, Neb. A combined register and ledger is provided by this invention which is arranged to afford convenient means for posting the sales in the ledger at the time they are entered upon the register. It comprises a set of leaves constituting the ledger and another set the register, the leaves being on a common writing surface in sight of the user.

THERAPEUTIC DEVICE.—C. E. MACARTHY, 223 West Chappel St., Griffin, Ga. The device comprises two levers pivoted together and arranged opposite each other, the inner sides of their longer arms being curved outwardly and a spiral spring interposed between the shorter arms of the jaws, which are extended in the same plane with their longer arms.

BURIAL STRUCTURE.—F. M. ROGERS, care of E. Nicholson, 73 Madison St., Seattle, Wash. This burial structure consists of a chapel in which burial services may be held, a receiving vault for temporarily receiving bodies, and thoroughly ventilated crypts as a final resting place for the bodies. In the floor of the chapel is an opening normally closed by an elevator platform on which the burial casket may be supported. The elevator provides access to the receiving vault underneath the chapel and the wings extending outwardly therefrom.

SUBMARINE MINE.—G. E. ELIA, Rome, Italy. An object of the invention is to provide a floating cable with mines suspended at each end, so that the cable when struck by the bow of a ship will be dragged along with the latter, so as to cause the mines on the ends of the cable to be drawn inwardly and into contact with opposite sides of the hull of the ship, when the mines will be exploded, with the effect of destroying the ship.

SMOKER'S POUCH.—C. TWINING, 39 Leonard St., New York City, N. Y. The invention provides a smoker's pouch consisting of an outer envelope and an inner envelope, adapted to be disposed within the outer envelope, the latter being provided with means for holding a pipe, while the inner envelope constitutes a container for the tobacco.

DISPLAY RACKS FOR WINDOWS.—M. R. WOOD, 218 William Street, New York. With the object of displaying merchandise to best advantage in show windows, the present invention consists of a bracket which may be secured to the casing of the window and a tubular arm with interlocking means for attaching the arm to the bracket, so that the arm will project therefrom at an acute angle.

METHOD OF COLLECTING PARTICLES PRESENT IN AN IONIZED MEDIUM.—W. W. STRONG, care of Scientific Instrument and Electrical Co., Mechanicsburg, Pa. The purpose of this invention is to provide a method of indicating the presence of smoke, dust, fumes, mist, or other particles present in flues and pipes as a means of checking the time when they are given off through the flues and the pipes and the relative amounts of the particles at such time. The invention is based upon the ionization of different media and proceeds upon the fact that particles present in an ionized medium may be collected through the use of an electric field.

APPARATUS FOR DRYING WASHED BIRDS, DOGS, AND OTHER ANIMALS.—R. G. FURLEY, address Day, Davies & Hunt, 321 High Holborn, London, W. C., England. For the purpose of drying washed birds, dogs and other animals when intended for show purposes, in a quick and efficient manner, the present invention provides a cylinder divided into compartments by screen partitions, also an air-heating chamber, and an air-extractor, to draw the air through the cylinder.

PAPER CASE.—M. W. FASSMANN, P. O. Box 385, Fayetteville, Ark. This invention relates particularly to cases adapted and intended for holding rolls of paper, and particularly useful as a receptacle for mileage tickets, stamps, cigarette papers and other articles requiring the delivery from time to time of sheets or strips of paper.

FIRE ESCAPE.—A. F. JONES, Nelson, Butte Co., Cal. This invention avoids marring buildings; provides a movable fire escape operable from a station accessible to an operator standing on the ground; provides means whereby the operative position of the escape is ascertainable without recourse to the escape directly; provides a structure arranged to prevent the parts thereof from becoming jammed or locked, and provides an escape for every window in the side of a house.

DEVICE FOR STACKING MAIL MATTER.—E. P. F. THOMPSON, Troy, Tex. This invention has reference to a device for use in stacking letters, circulars, newspapers, and other mail matter ready for tying in bundles. It is the design of the improvement to provide an article simple in construction, efficient in use, and capable of being folded into small compass when not required for use.

WIND SHIELD FOR MATCH BOXES.—F. C. LAMBERT, 242 E. Tremont Ave., Bronx, N. Y., N. Y. This wind shield is arranged for convenient attachment to match boxes, such, for instance, as contain safety matches in a drawer slidable in a casing, the wind shield when not in use folding upon the casing, and when extended for use permits of safely igniting a match for lighting a cigar or other article.

REMOVAL OF WATER FROM WET CARBONIZED PEAT.—N. TESTRUP, 6 Broad Street Place, and O. SÖDERLUND, "Fairlawn," Clarence Road, Chapham Park, London, England. Externally and preferably slowly applied sustained pressure is used in removal of the water. This treatment preferably following a preliminary treatment in which pressure applied internally is used, i. e., pressure transmitted by the fluid itself. For this purpose, the wet material may be passed into a filter press and the water which is readily expressible therein removed in this way, a further quantity of water being then removed by subjecting the cake to pressure externally applied by a band or like press.

DENTAL CROWN REMOVER.—R. H. TAYLOR, Meeker, Colo. This inventor provides means for removing crowns or coverings from teeth by careful and painless application of force, to lift the cap or covering from the tooth to which it was applied; applies the force necessary for the removal of the crown or covering, at a distance from the tooth, for the convenience of the dentist; and provides a guide-plate from the tool having a peep-hole opening to guide the placement of the tool.

PIPE CAP.—S. N. MALTERNER, Canton, N. Y. In this instance means are adapted to engage exteriorly with the bowl whereby the latter will not be defaced. The cap serves to prevent the lighted tobacco from being blown out of the bowl, especially when traveling or automobiling or in windy weather, although the improved cap will prevent extinguishing of the lighted tobacco in stormy weather and will serve to permit the proper draft and burning of the tobacco.

GUN SIGHT.—J. R. STEWART, 1111 A St., Tacoma, Wash. The inventor provides a sight of strong construction, and contrasting colors, whereby the sight can be used efficiently under different light conditions. He makes a perfect connection between the head and the support for the same, so that the vibration of the barrel caused by the discharge or any other rough, hard usage will not dislodge the head from the support.

Machines and Mechanical Devices.

SAW TENSIONING AND STRAIGHTENING MACHINE.—T. W. ROACH, Lyman, Wash. The invention relates to a machine for operating on circular and other saws, for performing the work known as rolling saws for tension, the machine being useful also for straightening a concave saw that has been forced over the saw collar. The present invention provides an improvement on a saw tensioning and straightening machine previously patented by Mr. Roach.

SAW GUIDE.—C. DEVERELL, Woodstock, Ore. The invention provides a device for supporting a cross-cut saw for making kerfs on the under side of the log with the saw in inverted position. The construction is such as to possess more strength and simplicity than devices ordinarily employed, while eliminating devices which are liable to become broken or disarranged.

GUIDE FOR SHARPENING BITS.—H. H. HOLMES, 527 Broadway, Council Bluffs, Iowa. In order to hold planing bits in proper position while they are being sharpened, Mr. Holmes has invented a support having means for securing the bit thereto and a roller member associated with the support, forming means whereby the desired cutting angle of the bit is obtained when the plane is sharpened.

EXPENSE TABULATOR.—E. L. BROWN, care of Alfred R. Rodway, 100 Hudson St., New York, N. Y. This invention refers to an expense tabulator which is intended primarily for use by traveling salesmen, whereby each expense as it is incurred can be easily and conveniently recorded on a strip of paper or other table contained in the device for daily or weekly records, there being a suitable printing mechanism that is adapted to be manipulated for printing on the tape various items of expense and amounts thereof.

INTERDECK DAVIT.—R. TJADER, 51 E. 42nd St., New York, N. Y. The invention more definitely stated provides an easily controllable and safe means for launching lifeboats from various decks or between decks of a ship, whereby the confusion and loss of time incident to attempting to launch all the lifeboats from the upper deck only are obviated.

QUARTZ MILL.—H. F. RANDALL, Tiffin, Ohio. An object of the invention is to provide a device having shoes disposed on a frame which may be oscillated in a horizontal plane. A further object is to provide a device of this type, in which the horizontal oscillating frame may have a vertical movement, so as to ride over and crush larger pieces of the rock.

CAN TOP FEEDER.—C. E. FORRY, address H. L. Guenther, care of Angelus Sanitary Can Machine Co., 310 North Ave. 19, Los Angeles, Cal. The can tops are taken, one by one, from the bottom of a stack, a separator being provided to prevent more than one from being taken at a time, and then they are caught by the arms of a feed wheel, which carry them to the point of delivery.

Prime Movers and Their Accessories.

GEARING.—J. M. J. NESS, care of Dakota Implement and Hardware Co., Maddock, N. D. The object of the present invention is to provide a device of a simple nature for converting the rotary motion of a windmill into reciprocating motion for working the pump rod. The device is so designed that the gearing is enclosed in an oil reservoir, securing perfect lubrication.

OILER.—A. SCHOEL and A. E. BAUM, 42 Lafayette St., Waterloo, Iowa. Most of the windmills which have been in use for several years are so badly worn that it is difficult to connect with them any of the oilers now in use in such a manner as will insure an even and certain feed of the lubricant at all times. This fault is removed by the present invention, which provides for a positive delivery of the lubricant under all conditions.

ENGINE STARTER.—B. G. PATTERSON, 1136 W. 14th St., Oklahoma, Okla. This invention relates particularly to so-called "self-starting" mechanism for automobile engines. The engine shaft is spirally grooved at the forward end and carries a nut engaging these grooves. The driver operates a lever to draw the nut back along the shaft, causing the latter to rotate and turn the engine over, whereupon the nut is released by a ratchet mechanism.

Railways and Their Accessories.

RAILWAY SAFETY AND RECORDING DEVICE.—F. F. HUDSON, Memphis, Tenn. The invention comprises a train stopping mechanism, controlled by a closed track circuit, which will cause the stopping of a train by the application of brakes, and will also give warning in the cab of the engine to notify the engineer or fireman of impending danger. A recording device will record the obedience to or disobedience of signals by the engineer.

CROSSING ARRANGEMENT FOR BLOCK SIGNAL SYSTEM.—MARK CONRAD and W. G. KELLY, Adrian, Michigan. An object of the present invention is to provide an arrangement for preventing a collision of trains at the crossing of two roads, either one or both of which are equipped with a block signaling system. Means are provided by which the circuits are closed through the operation of crossing signals so as to supply current for certain train stopping mechanism carried by the engine.

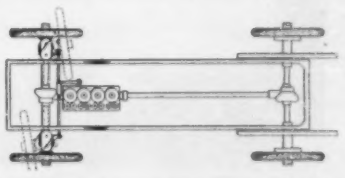
LOCOMOTIVE DRIFTING VALVE.—W. J. SAXON, 92 West 30th Street, Paterson, N. J. The invention provides means for supplying the cylinder and steam chest of locomotives with saturated steam to avoid the drying and sudden cooling incident to the heat of the superheated steam and the vacuum formed by the movement of pistons. Means are also provided for cushioning the pistons after the determination of the power steam supply in the cylinder.

Pertaining to Recreation.

APPARATUS FOR AQUATIC INSTRUCTION AND AMUSEMENT.—C. S. JACOBSEN, 587 Pacific Street, Brooklyn, N. Y. A novel apparatus for instruction in the art of swimming is provided by this invention. It embodies a large swimming pool having a circular concentric platform adapted to travel on the sidewall or rim of the tank, the same being operated by a suitable motor and also provided with means for supporting persons in the water, the element of danger being thus entirely eliminated.

Vehicles and Their Accessories.

FRONT AXLE DRIVE FOR MOTOR VEHICLE.—E. R. NICHOLS, 5716 Washington Ave., Chicago, Ill. The present invention comprehends an improved means for driving a motor vehicle and especially a farm tractor through a shaft carried by the front or steering axle. An improved universal joint is provided between the main part of the front axle and the spindle end so as to increase the pulling power and enable the tractor to turn short. Irregular motion of a universal joint on one side is neutralized by that on the other, so that motion of the tractor is uniform.



FRONT AXLE DRIVE FOR MOTOR VEHICLE.

EMERGENCY AXLE.—C. P. SNYDER, 69 Dowel Street, Slatington, Penn. The invention provides an emergency appliance adapted to be carried in the tool chest of an automobile and so constructed that in case of breakage of one of the driving axles, the wheel may be removed from the broken part and the emergency appliance connected to the remaining part of the axle and the wheel then connected to the emergency device.

HOLDER.—A. HARNISHFEGER, care of M. A. Strouse, Main and 2nd Sts., Evansville, Indiana. This holder is adapted for use on the side or rear of an automobile for carrying one or more extra tires, each held on a demountable rim, or for carrying wheels and the like. The holder is arranged to take up very little room, to prevent articles from being removed by unauthorized persons, and to allow of quickly removing the articles when needed.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The World's Largest Locomotive

(Concluded from page 479.)

tive, has 1,584 square feet of surface.

An interesting fact is that this locomotive has 89 per cent of the total weight of the engine and tender on the drivers, a gain which results from placing a set of driving wheels under the tender. The boiler contains 326 tubes 2¼ inches in diameter and 53 tubes 5½ inches in diameter, and their length is 24 feet. There are 6,418 square feet of heating surface in the tubes, 88 square feet in the arch tubes, and 380 square feet in the firebox and combustion chamber, making a total heating surface of 6,886 square feet. The superheater having a total heating surface of 1,584 square feet, makes the total equivalent heating surface 9,262 square feet. The grate area is 90 square feet.

The tender has a capacity of 10,000 gallons of water and of 10 tons of coal.

The exhaust steam from the right center cylinder passes to the front receiver pipe, and that from the left exhaust chamber to the rear receiver pipe. These pipes have ball and sliding joints which insure flexibility. The front low-pressure cylinders exhaust through the stack through a flexible pipe, and the rear low-pressure exhaust is carried through a feed-water heater, extending the full length of the tender, and is then discharged through a vertical pipe at the rear of the tank.

As showing how, even in mechanical matters, history will sometimes repeat itself, it is interesting to note that as far back as 1863, Archibald Sturrock, locomotive superintendent of the Great Northern Railway, in England, conceived the idea of utilizing the weight of the tender for traction, and built about fifty locomotives which carried an engine and drivers in the tender frame. A photograph and a line drawing by Mr. Herbert T. Walker of this early and most interesting locomotive are shown in the accompanying illustration.

In the Sturrock engines the weight of the tenders loaded was about 57,000 pounds. The middle axle was cranked and driven by a pair of inside cylinders, 12 inches in diameter by 17-inch stroke. The wheels were 48 inches diameter and were connected by outside coupling rods.

Steam for the tender engine was drawn from the main engine boiler and was controlled by a separate throttle valve. It was conducted to the tender cylinders through a pipe (visible on the photograph) from the outside of the steam dome. In practice this pipe was found sufficiently flexible without the intervention of compensation joints. The valve gear was the ordinary Stephenson link motion worked by a separate reversing lever on the tender.

The exhaust steam was delivered into a tubular condenser, which was surrounded by the water in the tank, and what remained uncondensed passed away through two short outlet pipes at the rear of the tender. These and other details are clearly shown in the accompanying drawing.

The tractive effort of these tenders was about 5,600 pounds. The engines to which they were attached were the ordinary English freight locomotives of the period; but their heating surface was slightly increased to supply the necessary steam to the tender cylinders. The leading dimensions of the engines were: Cylinders, 16 inches diameter by 24 inches stroke. Driving wheels, 60 inches diameter. Total heating surface, 1,082.26 square feet. Weight in working order, 73,900 pounds.

The tractive effort of the engine was about 11,264 pounds, which, added to that of the tender, made a total drawbar pull of 16,864 pounds.

The hauling power of these steam tender locomotives was nearly double that of the ordinary engines of the same class; for on a level road they drew sixty loaded cars, while the latter could pull only thirty-five cars on the same track.

Although a mechanical success, they were in advance of their time, for the trains they hauled were too long to be handled with convenience, since their length exceeded that of the side tracks. Moreover, on down grades the longer

trains were difficult to control with the inadequate braking power of fifty years ago. Another reason for their failure was that the tender caught the dust and grit from the engine, making the repair bills heavy.

Finally, the enginemen complained that they had practically two engines to care for instead of one, and their disfavor doubtless contributed to the want of success of these tenders, which, as Zerah Colburn (then the greatest authority on locomotive engineering) said, "deserve to be remembered as a contribution to the practice of auxiliary power."

The Launch of "Shamrock IV"

(Concluded from page 482.)

indeed, that it was necessary to provide extension chain plates in order to get sufficient spread for the shrouds to hold the towering rig in place. A novelty in the rig is the fact that some of the shrouds lead to a point one third of the distance from the masthead; and midway between their point of attachment and the deck is a second pair of spreaders. This method of staying suggests that the mast must be built extremely light in plating.

According to Winfield M. Thompson, the yachting expert, who is at Gosport for the purpose of observing the "Shamrock," she will have a sail spread of about ten thousand square feet. If this be true, the sail area will exceed that of "Resolute" by nearly 25 per cent, which is a truly enormous difference. The penalty due to her great sail spread and to the quarter-beam limitation will be large; and it becomes an interesting question whether the great power of "Shamrock IV" will suffice to wipe out the handicap she must give to whichever American boat is chosen, and still have in hand a sufficient margin of speed to make her the winner of three out of five contests off Sandy Hook.

Gustav Hamel

By Major H. Bannerman Phillips

THE finest of Great Britain's fliers lost his life in the attempt to cross the English Channel on May 23d, on his way from Paris to Hendon, where he was to have flown in the "aerial derby" on the afternoon of that day. The race was to start from there about 4 P. M., and after following a more or less triangular course around London, was to finish again at Hendon. Mr. Hamel had gone to Paris in order to fly over to England in the Morane-Saulnier monoplane with 160 horse-power Gnôme engine, with which he intended to compete in the race. He left Villacoublay at 4:30 A. M., landing at Le Crotoy, near Lille, about an hour later. He was afterward reported as having landed at Hardelot, and later at Boulogne. He is said to have left the latter place at half-past 1 o'clock, and afterward to have been seen over Calais. After that all traces of his flight were lost. The weather in the Channel on the 23d was extremely unfavorable for flying. There was a thick mist and a strong westerly wind, and the airman would have known well the significance of this state of things, for he had crossed the Channel in flights about twenty times during his career as an aviator.

The most complete and thorough search was commenced as soon as it was known that there were fears as to his safety. Various cruisers and destroyers and two sea-planes of the British Navy commenced to search the sea for traces of him, and the nature of the weather may be judged from the fact that both sea-planes were wrecked and the rough seas made hard work for the crews of the destroyers as they and the cruisers slowly patroled the Channel and swept the surface of every portion of the sea between England and France, where there seemed to be the slightest chance of finding any clue to the fate of the intrepid airman. The search was continued, both by day and night, as long as there seemed any chance of success, the various vessels keeping touch by wireless all the time. The watch and passengers on the cross-channel steamers also keep a lookout for any pieces of wreckage, and the French and English coasts were

examined by searchers of either nation, the French authorities taking an equal interest with the British in the operation, but all in vain.

From what is known of the route taken by Mr. Hamel, it seems probable that, in the first instance, he meant to strike the English coast at Hastings, but found the fog unfavorable to the longer sea-passage and then went farther east, in order to follow the Calais mail-steamer across and thus shorten the sea-journey as much as possible. The steamer having left when he reached Calais, he may have started for Dover, hoping to do the twenty-one miles in as many minutes, but getting caught by the fog, may have lost direction and been carried out of his course and over the North Sea, and finally, when his fuel gave out, he would be forced to come down out of sight of land, when his fate would be sealed. His monoplane was without floats, being intended for overland work, and it could not sustain him long on the surface of the sea, in any case. The circumstances of the voyage bear a painful resemblance to the last journey of the late Mr. Cecil Grace, who was lost in December, 1910, on the return over-sea flight from Calais to Dover in foggy weather.

Mr. Hamel was certainly the most experienced and the most distinguished of Britain's airmen, and he was, deservedly, one of the most popular, partly on account of his achievements, but also on account of his fine manliness and simplicity, to which was added a peculiar charm of manner. He was 25 years of age, and had displayed the greatest aptitude as an aviator of any man of his time; for since he qualified as an airman at Pau in 1911 he had shown himself to be as proficient in cross-country as in exhibition flying, and seemed to have a natural affinity for and knowledge of the air. He was the first pilot to cross the Channel with a lady as passenger, and also the first airman to make the London-to-Paris journey with a passenger in one day, and the first British airman to "loop the loop." He was looking forward with keen ambition to make the first attempt to cross the Atlantic in the Martinsyde monoplane which was being built for the purpose at the cost of Mr. E. Mackay, and which will be described at length in one of the forthcoming issues of the SCIENTIFIC AMERICAN. That his services in the cause of aviation from a national and patriotic point of view were duly appreciated, not only by the British public but by the government, was shown by the following communication in which the Admiralty made known their decision to abandon the search for traces of him on the 26th of May: "It has been decided to suspend the searching operations by flotillas and air-craft which have been in progress for the last forty-eight hours for Mr. Hamel. In relinquishing this quest, the Admiralty desire to place on record their recognition of the services rendered to British aviation by the missing airman. He was without question the foremost exponent in these islands of an art whose military consequence is continually increasing. His qualities of daring, skill, resource, and modesty merited the respect of those who pursue the profession of arms, and his loss, if this must be accepted, is received with deep regret by the officers and men of the Naval Wing of the Royal Flying Corps."

New Meteorological Units in Great Britain.

SINCE the first of May the daily weather reports of the British Meteorological Office have published all barometric pressures in millibars, instead of inches; rainfall in millimeters instead of inches; and wind velocities in meters per second instead of miles per hour. The vertical component of solar radiation, as measured at South Kensington, is given in joules per square centimeter, and its rate in milliwatts. Temperatures, however, are still given in these reports in the old-fashioned Fahrenheit degrees. The Royal Meteorological Society has decided to use millibars in the series of pressure normals for the British Isles, which it is now preparing. The barometers hereafter issued by the Meteorological Office will be graduated in both baromils and inches. (The baromils of the scale-reading are reduced to millibars, or absolute units of pressure, by applying appropriate connections.) Another new unit now used in Great Britain is the leometer (pronounced with the stress on the penult). This is defined as "the potential energy of unit mass raised through 1 meter against an acceleration of one 'leo,' or of unit mass raised through $1/g$ meters against the acceleration of gravity," and is a substitute for Prof. Bjerknes's "dynamic meter." The new unit of acceleration, 1 dekameter per second, is named "leo," in honor of Galileo. The leo and the units derived from it were introduced by Mr. J. W. Whipple, of the Meteorological Office.

An Industrial Education Convention

THE second convention of the National Association of Corporation Schools will be held in Philadelphia from June 9th until June 12th, inclusive. The first convention, held last Fall, took place at Dayton, Ohio; the meetings were held at the National Cash Register building. The meetings of the coming convention will be held in the new auditorium of the Curtis Publishing Company, at Sixth and Walnut Streets.

The National Association of Corporation Schools is an association organized for the furthering and developing of industrial education by employers. Its members are the corporations and firms who have taken positive steps in the forwarding of industrial training by organizing schools in which their new employees are taught what to do and their old employees are trained to higher degrees of efficiency.

Its field of operation lies right alongside the field of operation of the National Society for the Promotion of Industrial Education. The purpose of the National Society is to develop industrial and vocational training in the public schools. The National Association begins where the National Society stops; it takes the public school graduate just entering business and trains him for the particular work of the concern into whose employ he is entering. The purpose of both organizations is to train the man to be of the greatest value to society and business and to enable him to *earn* the largest possible salary.

For the past hundred years the efforts of the great minds of business have been directed to developing and improving the mechanical agencies of production, trade, and commerce. In the agricultural districts, the steam reaper and harvester do the work of hundreds of hands. In factories, every effort has been bent to produce labor-saving machines of greater and greater efficiency. Sixty years ago the "Clermont" ran up the Hudson; now we have the "Vaterland" and the "Aquitania."

It is recognized, in fact, that in our strivings to improve the machines and methods over which our employees are to exercise control, we have taken no steps to improve the employees themselves. Quality of production is not the result of machinery alone, but of brains as well. And we have not taken the trouble to train the brains. From now on it is a man problem.

The realization of the one-sidedness of this development is what has prompted the organization of the National Association of Corporation Schools.

The Curtis Publishing Company, a member of the association, will act in the capacity of host to the visiting delegates at the sessions. Among speakers at the convention will be Arthur Williams of the New York Edison Company, president of the association; E. St. Elmo Lewis, of the Burroughs Adding Machine Company, and Charles P. Steinmetz, of the General Electric Company.

The meetings of the convention will be open to representatives of any business houses who are interested in the possible adaptation of industrial education to their own work and who will be interested in hearing the discussion and in talking with the members.

ELECTRONS AND THE ELECTRONIC THEORY are discussed by Sir Oliver Lodge in Scientific American Supplements 1428, 1429, 1430, 1431, 1432, 1433, 1434. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

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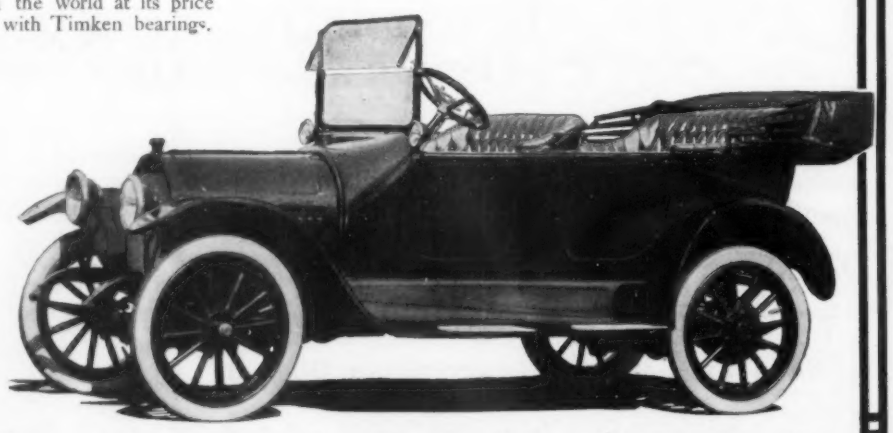

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